MARINE REVIEW

Entered at Cleveland Post Office as Second-class Mail Matter.

VOL. XXIII. Published every Thursday at 418-19 Perry-Payne Bldg., by the Marine Review Pub. Co. CLEVELAND, O., JUNE 13, 1901. Subscription $3.00 a year. Foreign $4 50 a year. No. 24

WORKS OF THE NEW YORK SHIP BUILDING CO.

AMERICA'S LATEST GREAT SHIP YARD.

Nearly all of the engineers who have been visiting America from different parts of the world to note our progress in the manufacture of iron and steel make a trip to Camden, across the Delaware river from Philadelphia, to see the new works of the New York Ship Building Co. They go away wondering at the great engineering skill shown in its design and equipment. It is truly a magnificent plant, embodying more radical departures in ship building than are to be found in any other works in the world. Many of the ship builders of this country, upon seeing the Camden works, were so impressed with its magnitude that they predicted failure for the whole enterprise on account of the enormous outlay of money before a ship was built and on account also of the evidence of heavy costs in operation and maintenance. Probably the answer to this criticism is that the volume of work to be done at the new yard is to be in keeping with its immense capacity. This certainly seems to be the course upon which the management has embarked, as they already have under order ten very large merchant ships. Information regarding two of the vessels is withheld, but eight of them, aggregating 124,900 tons displacement and 74,600 tons deadweight capacity, are described on the following pages.

HENRY G. MORSE,
ORGANIZER AND PRESIDENT OF NEW YORK SHIP BUILDING CO.

Before passing to a description of the vessels and the ship yard with its wonderful equipment, it may be well to refer briefly to the enterprise in a general way. Henry G. Morse, the moving spirit in this gigantic undertaking, began work upon it little more than two years ago. The Camden site was decided upon in January, 1899, and in the following month the capital was practically all subscribed. The property was not purchased until July, 1899. Today thousands of tons of material is being worked up for the ships above referred to, and when they are well under way, within the next month or two, a force of probably 4,000 men will be employed. The company got its name principally because one was desired that in any part of the world would suggest America, and partly because the first idea, if not intention, was to locate the plant in New York harbor. That purpose was abandoned for the reason that no suitable site could be found within ten miles of the Battery that could be procured, except at a cost five to ten times as great as an equally good site elsewhere.

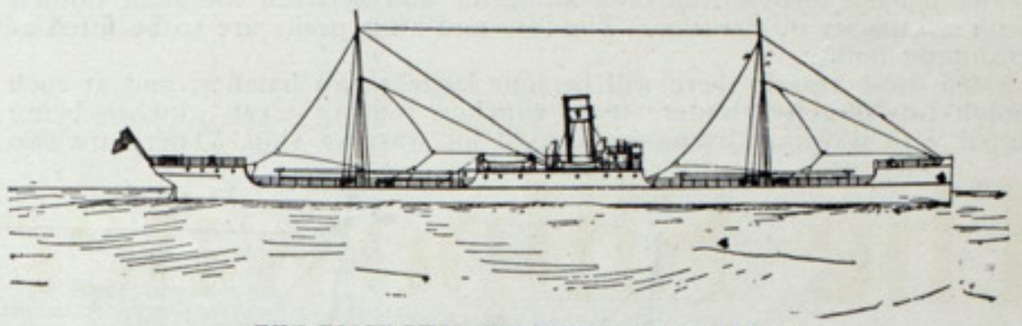
A wonderful feature of the plant is the assembling in one stupendous main building and under one roof of all the material and machinery necessary to the construction of the largest ship known to commerce; and this means that eight sets of ships' ways, built upon masonry foundations, covered by roofs of steel and glass and spanned by cranes up to 100 tons lifting capacity, are practically as much a part of the immense main building as the boiler shop or machine ship. Only the departments from which there is most danger on account of fire—woodworking shops and power house—are separated from this main structure. About 3,600 feet of river frontage, a machine shop with four acres of floor space, a storage house for 20,000 tons of plates, shapes, etc., and place also for 10,000 tons more of this material in finished form, are other features of the works. It has been well said that the designer of the plant was evidently familiar with the conditions necessary to the quick and economical construction of ships; he had the courage to depart from ordinary methods and attempt something new, and his stockholders had sufficient confidence in him to provide him with all that he required. The plant has been laid out to achieve economical results in the beginning—not to grow into economical methods with the growth of business. It can be extended and enlarged, it is true, but the economies are there already; extension means little more than duplication of the existing plant.

Leading particulars of eight of the ships for which contracts have been secured, and which will soon all be under way, follow:

EIGHT LARGE MERCHANT SHIPS.

CONTRACTS ALREADY UNDER WAY AT THE BIG SHIP YARD—SEVEN OF THE VESSELS ARE OF 5,000 TO 14 000 TONS DEADWEIGHT CAPACITY.

Order No. 1, upon which work is now nearing completion at the Camden works, M. S. Dollar, is a single-screw steel steamer of the following dimensions: Length over all, 309 ft. 7 in.; length between perpendiculars, 300 ft.; beam molded, 40 ft.; depth molded, 26 ft. This vessel is designed to carry about 4,000 tons on a draught of 22 ft. She is of the three-deck type, with poop, bridge-house and forecastle, and is built to class 100 A 1, at Lloyd's. The upper deck is of steel, complete, but the main deck consists of beams without the laid deck. In lieu of the lower deck web frames and side stringers have been fitted, leaving the hold clear for stowage of cargo. There is a cellular double bottom extending all fore and aft, used for water ballast, and the fore and after peaks are arranged as trimming tanks. The total water ballast capacity is 872 tons. The hold is divided into six water-tight compartments by five bulkheads extending to the upper deck. This ship has two steel pole masts, each mast being fitted with four cargo booms. There are four large cargo hatches and eight double-cylinder steam winches, suitably arranged for the rapid handling of cargo. On the forecastle deck is fitted a powerful steam windless of the "Hyde" kind for handling the cables and stockless anchors, and located on the poop is a reversible steam capstan for warping the ship. Both steam and hand steering gear (Williamson type) is provided, the steam gear being located at the after end of bridge house



THE FIRST SHIP, STEAMER M S. DOLLAR.

and the hand gear directly over the rudder stock on the poop deck. Accommodation for the captain and other officers, engineers and steward are arranged in the bridge house, and the fireman and crew are berthed aft in the poop. On top of forward end of bridge house is a large pilot house and chart room.

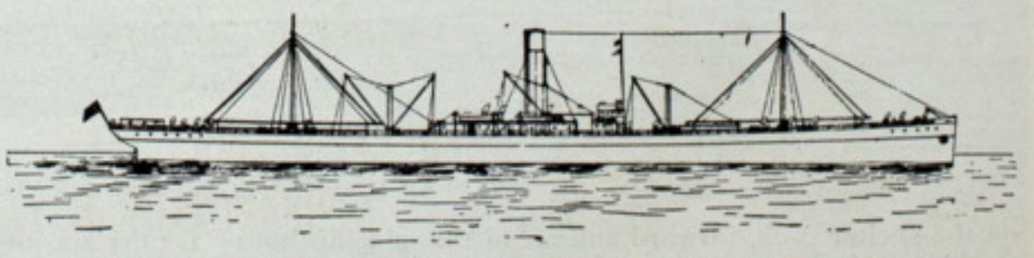
The engines of the Dollar are of the vertical, triple expansion type with cylinders of 22, 36 and 59 in. diameter and a stroke of 42 in. Steam is supplied by two single-ended Scotch boilers of 14 ft. diameter and 12 ft. 3 in. length, each fitted with three corrugated furnaces of 46 in. diameter and designed for natural draft. The steam pressure is 175 lbs. per square inch. There is a large donkey boiler, also working at a pressure of 175 lbs., and so arranged as to be used when desired in conjunction with the main boilers. The engines will develop about 1,500 I.H.P. and drive the vessel at 10 knots speed loaded.

The M. S. Dollar is building for the M. S. Dollar Steamship Co. of San Francisco and will engage in general freight business on the Pacific. She will be delivered in about one month.

THREE STEAMERS FOR AMERICAN-HAWAIIAN COMPANY.

The first of three vessels to be built to the order of the American & Hawaiian Steamship Co. will be named Texan and is intended to ply between New York and San Francisco. The other two are for Pacific trade. The Texan is to be a steel twin screw vessel of the following dimensions: Length over all, 484 ft. 3 in.; length between perpendiculars, 471 ft.; beam molded, 57 ft.; depth molded to shelter deck, 42 ft. 6 in. The vessel is being built to Lloyd's highest class under special survey and is also of the three-deck type with complete steel shelter deck extending all fore-and-aft. Her displacement will be about 16,200 tons at 27 ft. draught, giving a deadweight carrying capacity of 11,000 tons. This ship is being constructed on the deep-frame system with longitudinal stringers in lower hold. There are three complete steel decks, named middle, upper and shelter decks, and also a partial lower deck forward. The double bottom is of the cellular type and extends all fore-and-aft. The fore and after peaks are fitted for trimming tanks. There are also two deep tanks, one forward of the coal bunker bulkhead with a capacity of 942 tons of water ballast and the other arranged alongside of the shaft tunnels with a capacity of 222 tons. The total water ballast capacity is about 2,900 tons.

The equipment includes a very large Hyde steam windlass, fitted on the shelter deck, for handling the anchors and cables and also a powerful steam capstan. There are fourteen double-cylinder steam cargo winches,



FOR NEW YORK-SAN FRANCISCO SERVICE OF AMERICAN-HAWAIIAN CO.

two of which are arranged with warping drums for warping ship. Two heavy pole masts and four derrick posts, all standing vertical and fitted with a large number of booms, are arranged for handling cargo at the six hatches. A Williamson steam steering engine is fitted at after end of deck house and an auxiliary screw steerer is fitted directly over the rudder head. A complete electric lighting plant will be installed, the same being arranged in two units. Accommodation for captain, officers, engineers, etc., will be arranged in steel deck house amidship, with pilot house and chart room on top and on the forward end of same.

Engines of this vessel are of the quadruple expansion type with cylinders of 19, 28½, 41 and 60 in. diameter and a stroke of 42 in. Steam is to be supplied by three single-ended boilers of 15 ft. 6 in. diameter by 11 ft. 4 in. long, fitted with forced draft and having a working pressure of

215 lbs. per square inch. The Texan is expected to maintain a speed of 10½ knots loaded at sea.

The two vessels for Pacific trade of the American-Hawaiian company are to be named Nevadan and Nebraskan and are to be twin-screw steamers of the following dimensions: Length over all, 371 ft. 6 in.; length between perpendiculars, 360 ft.; beam molded, 46 ft.; depth molded to shelter deck, 34 ft. 8 in. They will have a displacement of 8,200 tons on a draught of 23 ft., giving a deadweight carrying capacity of about

FOR PACIFIC TRADE OF AMERICAN-HAWAIIAN CO.

5,300 tons at that draught. They are of the three-deck type, with a complete steel shelter deck extending all fore-and-aft, and built to Lloyd's highest class under special survey. The construction is to be on the deep-frame system with longitudinal stringers in lower hold. There are three complete steel decks, namely, middle, upper and shelter decks. A cellular double bottom extending all fore-and-aft will be fitted up for carrying water ballast; also a deep tank alongside and between the shaft tunnels with a capacity of 590 tons. The fore and after peaks are to be fitted as trimming tanks.

In these vessels there will be four large cargo hatches, and at each hatch two double-cylinder steam winches, four of these winches being fitted with warping drums to be used for warping ship. There are two heavy steel pole masts, the foremast having eight cargo booms and the main mast seven. One of the cargo booms on the foremast is designed for a load of 40 tons. Eight water-tight bulkheads will provide nine water-tight compartments.

These vessels are designed to use either oil or coal for fuel. The oil bunker will be located just forward of the boiler room bulkhead and will have capacity for about 600 tons of oil. The steam windlass is of the Hyde type and is located on the shelter deck. The steam steering engine is of Williamson Bros.' make and is located in the engine room. Large refrigerating spaces are fitted just aft of the engine room bulkhead and will be used for the carrying of fresh meats, fruit, etc. Accommodations for the captain, officers, engineers, etc., are arranged in a steel deck house amidship. There is also a steel deck house aft, with accommodations for oilers, firemen, cattlemen and crew. Auxiliary screw steering gear is fitted in the after end of this house. Portable fittings are to be arranged on the shelter deck, forward and aft of the midship house, for the accommodation of about sixty-two horses. A complete electric lighting plant is to be fitted in these vessels.

The machinery consits of two sets of triple expansion engines with cylinders of 19, 31 and 54 in. diameter and 42 in. stroke, steam being supplied by two single-ended Scotch boilers of 16 ft. 3 in. diameter and 11 ft. 6 in. length, fitted with forced draft and working at a pressure of 200 lbs. per square inch. There is also a donkey boiler of 10 ft. diameter and 8 ft. length, working at a pressure of 120 lbs. per square inch. These vessels are expected to make a speed of 12½ knots on trial on a draught of 23 ft.

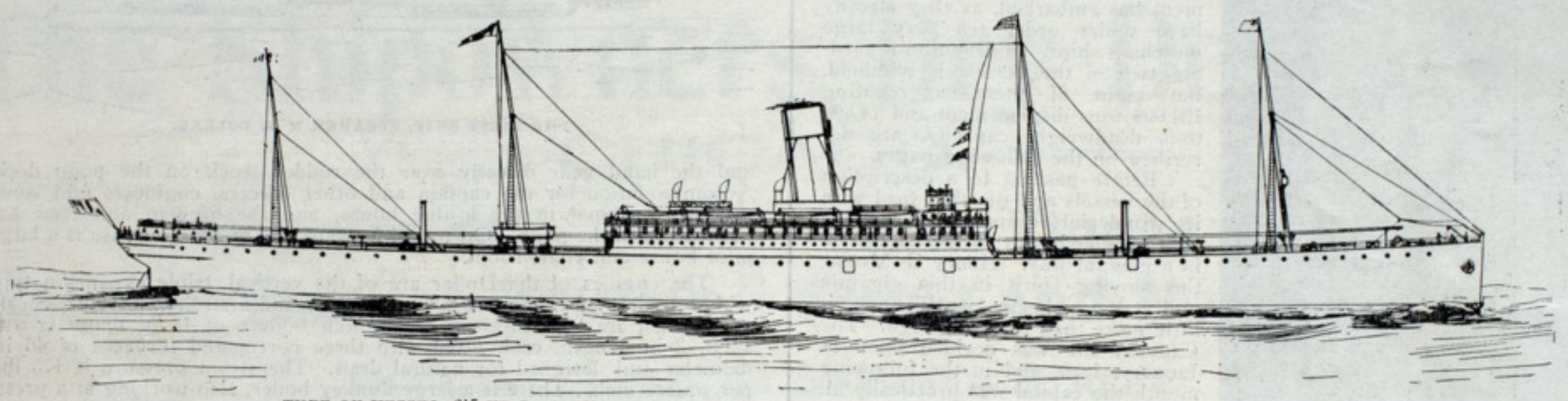
TWO SHIPS, 26,500 TONS DISPLACEMENT EACH.

The largest vessels under order at this great works are what are known as contracts Nos. 5 and 6—two steamers for the Atlantic Transport Line. These vessels are of the intermediate Atlantic type, designed to carry a large amount of cargo and a considerable number of first-class passengers. They are being built to Lloyd's highest class under special survey and will be specially strengthened to meet the severe requirements of the North Atlantic service. They are of the three-deck type with a complete steel shelter deck extending all fore-and-aft. The principal dimensions of these vessels are as follows:

	Ft.	In.
Length over all	615	3
Length between perpendiculars	600	0
Beam molded	65	0
Depth molded to shelter deck	51	3

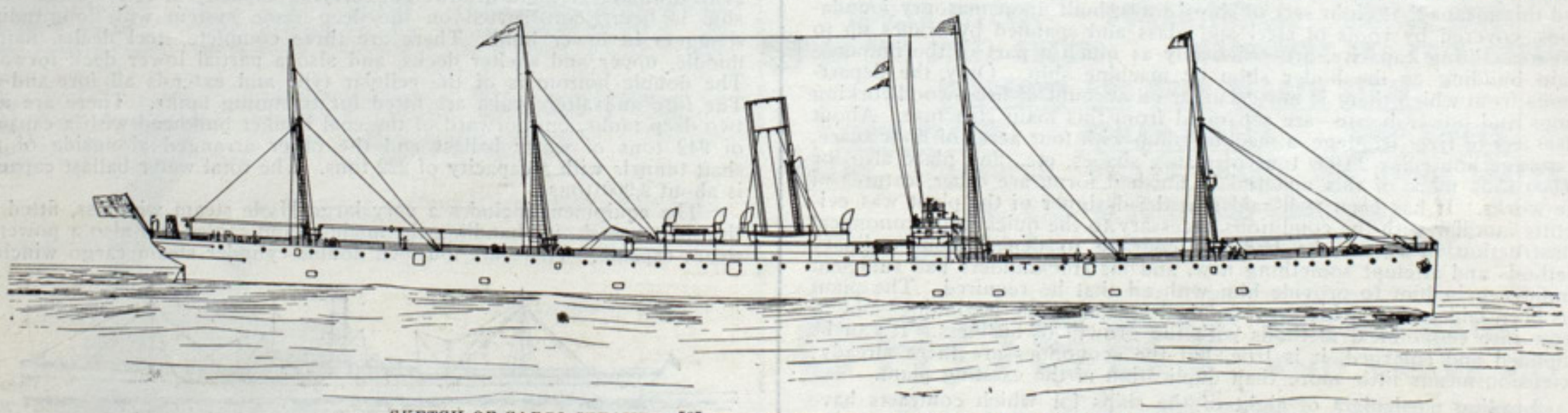
These steamers are designed for a draught of 33 ft., giving a displacement of about 26,500 tons and deadweight carrying capacity of 14,000 tons. The water ballast arrangements are: A cellular double bottom extending all fore-and-aft; fore and after peaks and five deep tanks with a total capacity of 4,263 tons. The vessels are divided into ten water-tight compartments by nine bulkheads extending up to the upper deck. There are five complete steel decks, namely, orlop, lower, middle, upper and shelter decks. Above the shelter deck is a bridge deck and also a promenade or boat deck, so that there are seven decks in all. Four steel pole masts and four steel derrick posts are suitably located for the rapid handling of cargo. Each mast is fitted with four cargo booms and each derrick with one boom, making a total of twenty cargo booms. Conveniently arranged on the shelter deck are nineteen double-cylinder steam winches. In each vessel there are ten cargo hatches.

Forward on shelter deck is located a very powerful steam windlass for handling the cables. Steam steering gear of a special type is located aft on shelter deck in a suitable deck house. Refrigerating space of 37,890 cu. ft. capacity is arranged in the after hold. This will permit of carrying a very large quantity of perishable freight to be carried. The vessels are to be lighted throughout by electricity, to be arranged in three units and of the usual marine type.



TYPE OF VESSEL, 615 FT. LENGTH, FOR FREIGHT AND PASSENGER SERVICE, ATLANTIC TRANSPORT LINE.

Accommodation for about 168 first-class passengers will be arranged in bridge house and in a deck house above the bridge house. The dining room is at the forward end of bridge house, extending the entire width of the ship, and will have seating capacity for 168 people. There is a galley, pantry, butcher shop, baker shop, and scullery conveniently arranged near the main saloon. Ample lavatory accommodation has been provided, there being several bath rooms and also a number of private baths. Opening onto the promenade deck is a large library, also a smoking room, the library being at the forward end of the boiler room casing and the smoking room at the after end of engine casing. Just forward of the library, accommodations are provided for the captain and officers. The boatswains, carpenters, quartermasters, seamen, oilers, firemen and cattlemen are berthed in the extreme forward part of the vessel below the shelter deck, and the stewards and cooks are located at the extreme after end of the vessel below the steering engine house. The life boats are ten in number, eight of which are located on the promenade or bridge deck and two are on skids aft of the after end of bridge house. These vessels are being fitted up for carrying a large number of cattle and horses, and special attention is being paid to the proper ventilation of these spaces.



SKETCH OF CARGO STEAMER, 505 FT. LENGTH, FOR ATLANTIC TRANSPORT LINE.

The propelling machinery consists of two sets of vertical, quadruple expansion engines with cylinders 30, 43, 63 and 89 in. diameter and 60 in. stroke. Steam will be supplied by eight boilers, four double and four single ended. The double ended boilers will be 14 ft. 5 in. diameter by 19 ft. 4⅝ in. long, and the single ended boilers 14 ft. 5 in. diameter by 10 ft. 10½ in. long; all fitted with forced draft and to work at a steam pressure of 215 lbs. per square inch. It is expected that these vessels will maintain a sea speed of 15 knots loaded.

TWO MORE LARGE STEAMERS FOR ATLANTIC TRANSPORT LINE.

Two more large freighters for the Atlantic Transport Line are to engage largely in carrying cattle and horses and are intended for the company's New York and London trade. The principal dimensions are:

	Ft.	In.
Length over all	505	6
Length between perpendiculars	490	0
Beam molded	58	0
Depth molded to shelter deck	43	0

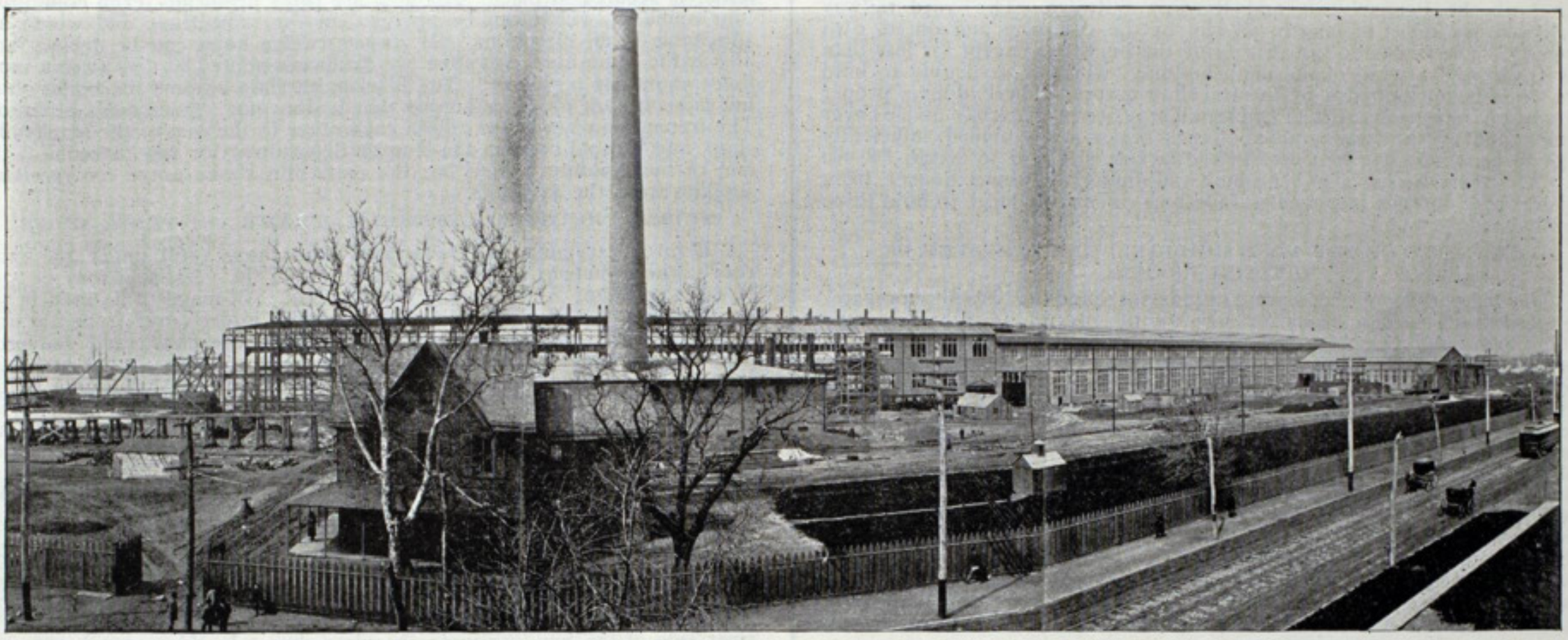
Four masts on each of these steamers will be rigged fore-and-aft. They are being built under special survey to take the highest class in Lloyd's register. They are of the three-deck type with four steel decks extending all fore-and-aft, with the shelter deck specially strengthened for the Atlantic trade. Above the shelter deck is a long bridge house. A cellular double bottom is fitted all fore-and-aft for water ballast. Water ballast is also arranged to be carried in two deep tanks and in the fore and after peaks, giving a total capacity of about 3,700 tons. Ten water-tight compartments will be provided by means of nine steel bulkheads. A most complete system of ventilation has been arranged to insure the safe carriage of grain and other cargoes. There are eight hatches and fifteen double-cylinder steam winches. A large number of derricks are provided for the rapid loading and discharging of cargoes. A powerful steam windlass of the Hyde kind is fitted forward for working the cables and a combined hand and steam steering gear of special design is fitted aft on the upper deck. These vessels will be lighted throughout by electricity and will be fitted in all respects as first-class cargo steamers, including all modern improvements necessary for the Atlantic trade. Arrangements have been made for carrying cattle and horses, the distribution being as follows: Cattle on the shelter deck, 122; cattle on upper deck, 593; horses on upper deck, 36; total cattle and horses, 751.

There are two sets of triple expansion engines, with cylinders of 25, 42½ and 72 in. diameter and 48 in. stroke, steam being supplied by four Scotch boilers, two of which are single ended of 14 ft. 5 in. diameter and 11 ft. 2 in. length, and two double ended of 19 ft. 10¼ in. length by 11 ft. 2 in. diameter; all fitted with forced draft and working at a pressure of 200 lbs. per square inch. The displacement of these vessels will be 17,000 tons on a draught of 27 ft., giving a deadweight carrying capacity of about 10,500 tons. Their speed will be about 12 knots.

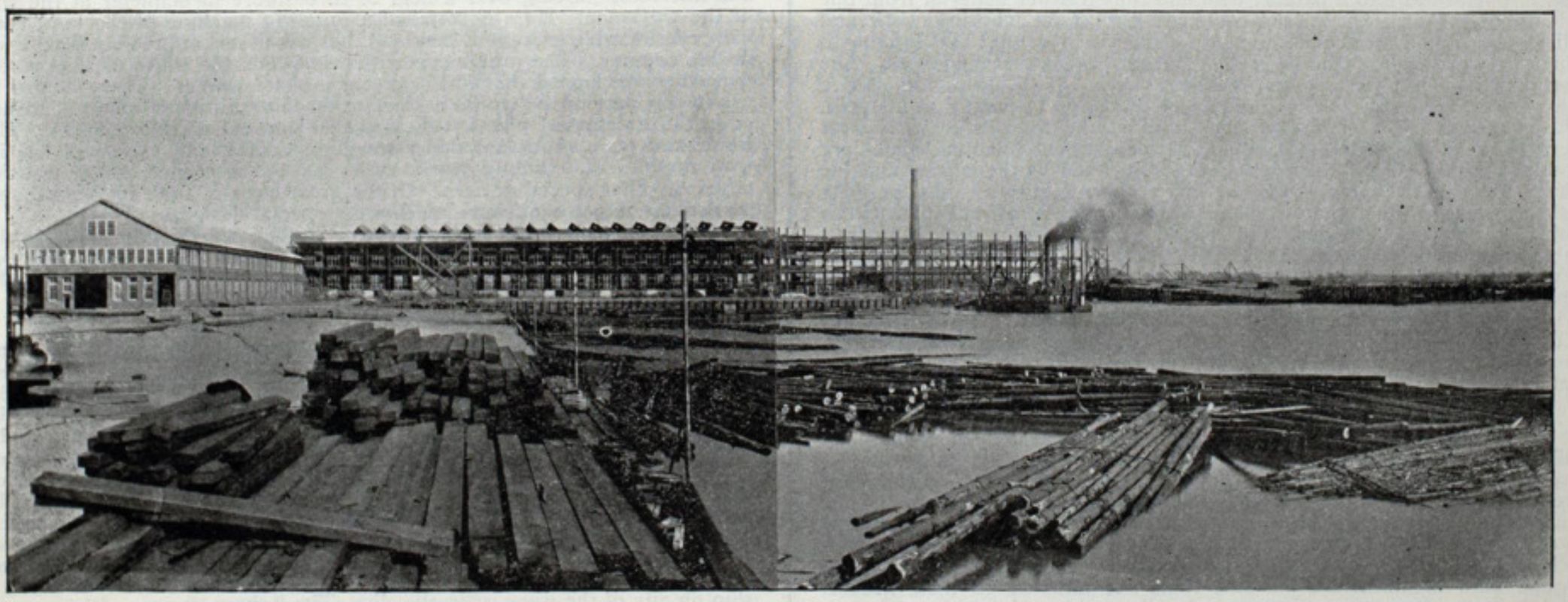
GENERAL DESCRIPTION OF THE WORKS.

A TRACT OF 130 ACRES OF GROUND—WAYS TO ACCOMMODATE SHIPS OF 650 FT. LENGTH AND DESIGNED FOR EXTENSION TO 1COO FT.—STUPENDOUS MAIN BUILDING COVERING UNDER ONE ROOF ALL DEPARTMENTS EXCEPTING THOSE ENGAGED ON WOOD WORK.

Probably it will be well in turning now to the great works of the New York Ship Building Co., where the several vessels just described are to be built, to direct attention at the outset to the two large half-tone engravings, one a view of the plant from Broadway, the main street of Camden, and the other a view of the river front. Unfortunately the officials of the company have not been disposed to permit of the publication of a general sketch of shops, ship ways, etc., and these pictures do not by any means show the establishment in its present state—almost completed under the original plans—but they are the best that are to be had and will at least assist in an understanding of the written description. The tract of land on which the plant is located lies between Broadway and the Delaware river, with a creek on the south and the Reading railway on the north. It is reached by two lines of trolley in the city of Camden and by the Reading and Pennsylvania railroad systems, each of which has its independent connection with the plant. The property has a frontage on the Delaware river of 3,600 ft. and a width from the riparian line of from 1,500 to 1,800 ft. The depth of water at low tide over the whole length of the riparian line is from 38 to 40 ft. The underlying strata is white sand and gravel, with some clay, making the best possible foundation for a ship building plant. Piles can only be driven to a depth of from 6 to 8 ft. This tract contains in all 130 acres, in addition to which is a lot of two acres on the opposite side of the street on which the main office is located. This large office building is not shown in the illustrations. Another plot was purchased on which are located the connecting lines of



A VIEW FROM BROADWAY, CAMDEN, OF WORKS OF THE NEW YORK SHIP BUILDING CO., WHILE UNDER CONSTRUCTION.



VIEW FROM DELAWARE RIVER FRONT OF WORKS OF NEW YORK SHIP BUILDING CO., WHILE UNDER CONSTRUCTION.

the New York Ship Building Co., with the Reading and Pennsylvania railroads.

The buildings, which are enormous in size, have been located upon this property, with these ideas in view: First, convenience in the transfer of material from one field of operation to another until the finished piece is ready for installation in its proper place on the ship as it stands upon the ways; second, the arrangement of the ways to accommodate ships 650 ft. long, and to allow for extensions, so that ships 1,000 ft. in length may be built under cover; third, an arrangement of shops that will permit an increase of from 50 to 100 per cent. in capacity; fourth, such isolation of structures as will reduce to a minimum dangers from fire; and fifth, facilities for the ready handling of materials received by rail or water. Broadway, the street above referred to, and which is shown in one of the general views, may be regarded for descriptive purposes, as running parallel to the river. On the line of Broadway throughout the length of the property the company has reserved a strip of 120 ft. wide, which is wholly unincumbered by buildings or otherwise. Adjoining this reservation is another strip 128 ft. wide, extending the whole length of the property, which is reserved for railway and highway purposes. There is ample room on the reservation for six parallel tracks, each 3,000 ft. long, connecting with both the Pennsylvania and Reading railways. The yard railway tracks are six miles in length, all laid by the company and on its own property. The tracks do not run inside the buildings except for less than 500 ft. through a wing of the main building, which is used only to hold cars while being unloaded by the traveling cranes. The buildings proper are entirely free from railroad tracks, all transfer of materials under cover being made by overhead cranes. Track scales are provided sufficiently large to accommodate two cars of the largest size and to weigh 300,000 lbs. A coal trestle has also been built (adjoining the power house), from which coal is dumped into coal storage bins sufficiently large to hold three months' supply.

IMMENSITY OF THE MAIN BUILDING—GREAT SYSTEM OF ELECTRIC CRANES.

The magnitude of these preparations for handling supplies prepares the mind of a visitor in some measure for the marvelous sight presented by the main building, which runs parallel to the railway reservation above mentioned, and has a wing extending over the tracks, so that materials may be unloaded under cover as above described. The main building is stupendous in size, and unlike any ship building plant elsewhere. Under one roof, and that roof more than 150 ft. above the ground floor, are the machine shop, boiler shop, blacksmith shop, frame shed, plate shop, general storeroom, brass shop, pipe shop, copper, tin and light plate shop, mould loft, building ways and outfitting slip, and these have a floor space of eighteen acres and are lighted by four acres of skylights and two acres of window surface. There are no railroad tracks, or open runways, occupying valuable floor area; there is no shafting to waste power and to obstruct the crane service; there is no smoke in the blacksmith shop to obscure the light; and the assembling of the whole plant under one roof has diminished the amount of exterior wall, and made the task of heating the plant one of comparative ease.

The arrangement of parts in this main building has been so carefully planned that the work progresses from one operation to another with the least possible handling. The building contains more than forty traveling cranes, ranging in lifting capacity from seven to 100 tons. All are driven by direct current electric motors. The huge 100 ton crane is carried on a span of 120 ft. and its field of operation covers the machine shop, ways and slip, so that it may be employed to lift an engine or boiler bodily from the machine shop and deposit it in a vessel under construction, either on the ways or afloat. Each of the smaller cranes has its own field of operations, and an original type has been installed which, by means of an extension arm, is able to deliver and receive material from another crane without rehandling; in other words, it can reach over beyond its ordinary field of operations into a parallel field and thus transfer material from one field to the other. These cranes obviate almost all laboring work and relieve the skilled mechanics of many elements of danger and fatigue to which they are exposed in shops that do not have these appliances. The workman does not have to lift anything heavy. If he desires to shift a heavy piece he signals to the engineer of the crane operating in his field, and by means of the crane the piece is lifted and transferred with great nicety to a new position. Cranes in the department handling plates are equipped with powerful electro magnets, controlled by the engineer of the crane. Instead of having to employ half a dozen laborers to lift the plate with crowbars while a chain is being slipped underneath and then to go with it to its place of deposit and release the chain by a similar process, only one man is required besides the engineer. The latter brings his electro magnet over the plate, turns on the current and the plate, now the armature of the magnet, can be lifted and carried to any place in the shop. It is instantly released by the turning off of the current. The only danger is that the current may be cut off in the dynamo room without warning, but that is to be guarded against by the use of current from a storage battery.

FOUR ACRES OF FLOOR SPACE IN A MACHINE SHOP.

Entering the machine shop, which is at the southern end of the main building (to the left in the general outside view of the works), one passes through a lower section into the nave, as it may be called, of the great structure, from which a splendid view is obtained of the interior of the great works. The vista extends almost as far as the eye can reach, and is scarcely obstructed. Far above move the traveling cranes, and below their level are galleries multiplying the ample floor space below. On the ground floor are immense machine tools not differing in their general characteristics from those common to all machine shops, but of such magnitude that they would appear colossal but for their surroundings. Nothing but an electrical switchboard gives any indication of the power that drives them. Here are forty lathes, two of them being 60 ft. from center to center, planing and boring machines that can operate on bed plates and cylinders of the largest size used. This shop in itself covers an area of four acres of floor space, which is completely filled with machine tools, all of which have been built within the last year, and each one of the heaviest design made; in fact, all of the large sized tools were made from special designs for this plant. Adjoining the machine shop is a tool room corresponding in its immense stock of tools and in the system attending the use of them by the workmen to the immensity of the plant itself. In connection with the tool room is a tool manufacturing and grinding room that contains enough machines to fill an ordinary shop. Here also are the clothes closets, the washing rooms, etc., for the use of the workmen, all fitted with the best sanitary devices for the comfort and convenience of the men. A low partition, which is scarcely noticeable because of its small size, compared with the magnitude of the building, marks the dividing line between the machine shop and the boiler shop.

BOILER SHOP, BLACKSMITH SHOP, ETC.

In the boiler shop there are many new appliances, and it may be noted in passing that throughout the works power of all kind is delivered —electric, pneumatic and hydraulic—so that at any point the workman can call to his aid the powerful engines of the generating plant. A boiler riveter of special design is arranged to operate with a pressure of 50, 100 and 150 tons, the cylinders all being outside packed and easy of access. The rivets themselves are made on the premises, of commercial sizes, but no time is wasted in putting them in kegs for use. They are transferred direct to great steel bins, from which they are drawn as required, falling by gravity into trucks, by which they are conveyed on board ship. Upon the table of another remarkable tool, an immense boiler riveter, boilers of 6 to 20 ft. diameter and 20 ft. length can be mounted for drilling. The boiler is secured in place. About it are three drillheads, each containing four spindles, which can be operated at the same time, and which are adjustable in all directions. By its use twelve holes can be drilled radially at the same time, and then the drillheads shifted to drill twelve more holes about the periphery. The blacksmith shop adjoins the boiler shop, but is so free of gases or smoke that it does not attract one's attention. The frame and plate shops adjoin each other to the east of the blacksmith shop, and beyond them is the storage department for raw material at the end of the building, which has the extension above noted for receiving supplies from the railroads.

STORAGE HOUSE FOR MATERIAL—FRAME AND PLATE SHOPS.

Before describing the frame and plate shops (still under the same roof), where material is prepared for hulls of the vessels, it may be well to say something of the storage departments. All metal to be used in the construction of a ship is received and remains under cover from the time it is unloaded from the cars until the ship is completed and delivered. The raw materials of chief importance are plates, frames, tubes and castings. The castings go to the machine shop to be finished, some of the plates and the tubes to the boiler shop, and the remaining plates and the frames to the plate and frame shops. While they are in storage they are disposed so as to be easily accessible. Instead of being piled one upon another, as is the usual custom, with the risk that the one first wanted may be at the bottom of the pile, the plates are set upon edge in racks, and any one of them may be easily extracted by means of the traveling cranes without disturbing the others. A similar system governs the storage of tubes, angle irons, etc., and all of these materials are in charge of a storekeeper, from whom nothing can be obtained, except upon order. The building at the north end is twice as wide as in the machine shop. The general storeroom, occupying the entire width, opens out on the river side of the building upon the plate shop. In this space 20,000 tons of raw material as received from the mills may be stored, and provision is also made for the storage of 10,000 tons of material which has been finished and is ready for erection in the ship.

The frame and plate shops are located side by side, and so arranged that the material passes through them from the material storage department, by what may be called a continual process, to the storage of finished parts. A great table or skidway set slightly above a constantly moving endless chain serves as the carrier of the plates, frames, etc., under the field of various tools of original design. The workman has only to insert a bar in the chain to carry the plate or angle iron or whatever it may be to the next machine, where it halts when the bar is removed. The magnitude of the tools is their chief characteristic, drills, countersinks and like tools moving over a field 20 ft. or more in diameter at the will of the workman. Here is installed a joggling machine of the kind used with considerable success in England, but which has only lately been tried in this country. The joggling machine so bends the edges of steel plates that wherever lapped they shall present a plane surface. There is also in use in this part of the works a scarfing machine, to plane off to a feather edge the great steel plates, which is also unusual in this country. The frame and plate shops are under traveling cranes, and each tool has its own method of handling work, either by boom cranes, skids, transfer tables or other special devices. Of the great mass of tools in these shops, more than 80 per cent. were made from special designs.

The hull material, when completed, is delivered directly opposite the ship for which it is intended, and under the field of operation of fourteen traveling cranes, which will deliver the material directly in place on the ships.

THE IMMENSE LAUNCHING WAYS.

The launching ways are at the end of the plate and frame shops, and directly opposite the machine shop, where the engines are assembled. Here we have still the one roof, including the launching ways and the outfitting slip. The clear height of the portion of the building above the water is 125 ft. (higher than the Brooklyn bridge), and the depth of the water in the slip is 30 ft. at low tide. Eight launching ways have been constructed and all but two are ready to receive keels of ships. Each launching way will accommodate a ship 650 ft. long and this may be increased to 1,000 ft., as the declination is such that the ways may be extended into the river without great cost. The 100-ton crane travels over all the launching ways and the outfitting slip. As already noted, it can pick up a completed engine weighing 100 tons and deliver it on board a ship on any of the ways or in the slip. The lighter engines will be transferred bodily; if they should weigh more than 100 tons they will be partly dismantled for removal to the ship. Two other cranes of ten tons each and one crane of five tons travel over each of the launching ways and the outfitting slip. Adjoining the slip is a pier 72 ft. wide and 1,200 long, with 30 ft. of water on either side. In addition to this, another outfitting bulkhead, 1,000 ft. long, has been built, and a wharf 500 ft. long for the unloading of lumber.

WOODWORKING DEPARTMENTS AND POWER HOUSE SEPARATE FROM MAIN BUILDING.

Thus far the description of these works has been confined to a single building, in which all the work of constructing a ship and its machinery is carried on under one roof. There are other departments, however,

which are separate from the main building and from each other, as a precaution against the spread of fire. These buildings include warehouses, pattern shop, joiner shop, power house, paint shop and riggers' loft, each sufficiently removed from all other buildings that a fire occurring in any one may be confined to its place of origin. Besides this safeguard there is a complete system of fire protection, which has been installed under the advice and inspection of the most competent officers of the fire insurance companies. Power is furnished by three 1,500 gallon underwriters' pumps through mains ranging from 16 in. in diameter to the smaller sizes required, and the outside and inside of each building is thoroughly equipped with hydrants and hose.

Out on the river front, far removed from the main building, is the woodworking department. The general arrangement is like that of the main building. It has every facility for receiving supplies by water or by rail, but the timber is generally delivered by water. It moves through the dry kiln, the joiner shop and carpenter shop, from which it is transferred by rail and crane directly under the ship for which it has been designed or under the building covering the outfitting slip. It is thus, like the iron work, accessible to the traveling cranes. The woodworking department is at least 200 ft. from the main building and an equal distance from the lumber yard. The joiner shop is a two-story building, 300 by 75 ft. and the carpenter shop a one-story building, 150 by 50 ft., and each is completely fitted out with modern machinery. The paint shop, 50 by 100 ft., is isolated from all other buildings, being situated between the joiner shop and the outfitting slip, and is equipped with machinery for grinding and mixing paint. In addition to these isolated buildings are the general storage warehouse and pattern storage warehouses isolated from other structures.

The source of activity in all these great buildings is to be found in the power house, another separate structure, located between the main building and Broadway, on the line of the railway reservation, whence it receives its supplies of fuel. It is 175 by 110 ft., large enough to permit a duplication of all its parts. It has boilers of 2,500 H.P., installed by the Aultman-Taylor Co. of Mansfield, O., with a Greene economizer and the usual feed pumps and heaters. The gases are carried off by a brick stack, which is 200 ft. high and 8½ ft. inside diameter. It is built of hollow radial brick, and is the work of the Alphons Custodis Chimney Co. The stack is large enough for boilers of twice the capacity of those now installed.

THREE FORMS OF POWER PRODUCING APPLIANCES.

The machinery side of the power house is made especially interesting by the variety of its power producing appliances. Electricity, compressed air and hydraulic power are used in the shops, and the power house contains the electric generators, the air compressors, hydraulic pumps and accumulators. The main engines driving the electric generators are of 750 H.P. each, and were furnished by the Providence Engineering Co. They are directly connected to two 500 kilowatt Westinghouse dynamos generating direct and alternating currents of 250 volts each, which currents are used both for lighting the works and for power purposes. The general illumination is by 500 enclosed arc lights, furnished by the General Electric Co., while the individual tools and offices are lighted by incandescent lamps. Alternating current motors (Tesla system) are used to drive the larger machine tools, but the numerous traveling cranes are operated by direct current motors. The installation is of special design and has proved entirely successful. A dynamo, which is employed as an exciter for the fields of the chief generators, is used at night for the general illumination of the plant when the other machines are idle.

The main power house also contains an Ingersoll-Sergeant air compressor, capable of delivering 5,000 cu. ft. of air per minute. The piping from this compressor reaches the remotest part of the plant, and is of sufficient size to accommodate double the amount of compressed air now produced. In fact, enough room has been reserved to allow the installation of an equally large plant. The air pressure carried is 110 lbs. per square inch, and it is distributed by mains reaching every part of the plant. Some 300 portable riveters, caulkers, drills, etc., are now in use, and the number is being rapidly increased. A high pressure hydraulic system is furnished by two Barr pumps, with a capacity of 400 gallons per minute. The accumulators, one in the power house, the other in the center of the plant, are connected with the necessary pipes for the general distribution of this power, which is used chiefly for riveting. The pressure carried is 1,500 lbs. per square inch.

It will be seen by this description that without the use of shafting three forms of power are made available in all parts of the plant—electrical, pneumatic and hydraulic. They are applied to machines of all kinds, each according to its adaptability.

HEATING, VENTILATING, WATER SUPPLY, ETC.

The exhaust steam of the power house is employed in heating the plant by both the direct and indirect system, the mains ranging from 36 in. in diameter downwards to the smaller sizes. Although the main building is as far as possible enclosed, there is necessarily an open end leading to the ways. Here an ingenious screen has been interposed between the outer air and the shops. It consists of a coil of steam pipes, about 10 ft. in height, which produces a column of heated air that serves as a partition between the shops and the outer world. It does not heat the shops directly, but it protects them from outside cold. The mold loft, paint shop and exposed sides of the larger buildings are heated by radiators; the main buildings, joiner shop and carpenter shop are heated by the Sturtevant indirect system.

One of the interesting features of the plant is the water supply system. There are two 18-in. mains laid from the power house to the Delaware river, which can be operated independently or together. In addition to this there are fifteen 5-in. artesian wells sunk between the tracks of the railroad reservation, which supply drinking water to the whole plant and may be used to feed the boilers. The drinking water and the general service water is taken from the artesian wells only, the temperature of which is about 56° the year round. It is pumped to the offices and through the plant for drinking purposes, no ice being used to cool it. A complete sewage system also has been installed of sufficient capacity to carry off storm water as well as service water from the plant.

OFFICE BUILDING, LIBRARY, DINING DEPARTMENT.

The office building, as heretofore mentioned, is on the east side of Broadway, entirely separated from the workshops. In its way it is just as remarkable for the use made of modern labor-saving appliances as the workshops. It is a very plain structure, of the Colonial style of architecture, located on a lot 460 by 210 ft. The building itself is 130 by 116 ft. and is set back 50 ft. from the street line. It is impossible to tell, within the limits of an article of this kind, all about the details of a building that has been carefully designed from the floor coverings to the color of the walls and the kind of glass used in the transoms. A feature of the building is a great fireproof vault, in which archives are stored. The vault is subdivided in its several stories so that it contains every drawing and paper of importance that may enter into the work of the yard. The office building is intended for the use of the executive officers, the draughting and the accounting or business departments. It contains also the dining rooms, kitchens, etc., required in an establishment of this kind, located on a site far removed from hotels that are fitted to cater to the staff employed. The basement is given over almost entirely to the dining service. Two hundred persons may be entertained at a sitting. There is a private dining room for guests, one for the executive officers and one general dining room, besides kitchens, serving rooms, pantries, etc. A great deal of business can be transacted at the table, and the service is of a character entirely in keeping with the other characteristics of the plant. Besides the dining compartments the basement contains a bicycle room for the use of employes and a museum of articles used in the equipment of a ship, as well as toilet rooms.

The first floor is used exclusively for the executive departments. The officers of the company, the engineers, draughtsmen, estimators and librarian have rooms on this floor. There are two draughting rooms, one for hull and one for machinery, in skylighted additions to the main building, all on the first floor, and the arrangement is such that each officer is conveniently located with relation to the departments with which he has to deal. The librarian is an important official in this modern office building. He takes charge of all tracings and catalogues, books, magazines, estimates, letters, etc. He makes memoranda of all letters received before distribution, copies all answers and files the copy, takes charge of all tracings and delivers blue print copies thereof, catalogues and classifies all data relating to purchases and the cost of work, and has charge of the library, including periodicals as well as books. Periodicals are received in triplicate. One copy is bound; the other copies are cut up and classified. The librarian has many assistants, and this is one of the busiest parts of the great plant. The card catalogue system is extensively used, and the executive officers can obtain in a few minutes any desired data or information regarding the business of the office or current literature on the subject of ship building. Connected with the library department are the vaults heretofore mentioned, wherein are stored tracings, blue prints, etc., besides the stores of stationery, all being duly recorded in card catalogues before they are put away. The drawings are filed in iron trays, in racks erected in the fireproof vaults. The executive officers waste no time in filing drawings, or papers, or in copying letters. Everything of this nature is turned over to the librarian, who attends to the copying and mailing of letters, the cataloguing of archives and similar matters.

DRAWING ROOMS AND ACCOUNTING DEPARTMENTS.

The drawing rooms are especially interesting. There is one for the hull and one for the machinery, each in a sky-lighted wing of the main building, and each having above it, on the south side, a blue print room. The offices of the heads of these departments and their assistants adjoin the drawing rooms so that the chiefs communicate readily with either room. The rooms are splendidly lighted and are furnished with drawing tables at which some 200 draughtsmen are now at work. Smaller drawing rooms are attached to the offices of the civil and mechanical engineer on the second floor.

The second floor of the main office building is devoted almost entirely to the accounting department, and to the officers concerned in the maintenance of the plant. Here also are the photographing and blue printing rooms, in charge of the librarian. The office building is well provided with sanitary appliances. Lighting, heating and ventilation have all been cared for, and all the floors are supplied with artesian well water, flowing constantly at a temperature of 56° all the year round. One of the features of the office building is a telephone exchange of 130 telephones, by means of which every department of the works may be put into communication with every other. In a plant covering many acres this effects an immense saving, and economy of time and labor is the chief characteristic of the modern ship building plant.

An ingenious system of marking the parts that enter into a ship has been adopted by which, with the use of a few decimal numbers, the ultimate destination of a piece of machinery or plate is indicated. A whole number is employed, which is the number of the ship to which the piece belongs. That alone would keep it from going very far astray. The first number to the right of the decimal point designates the part as belonging to hull or machinery or other general classification. The number in the hundredths place designates a branch of that department and so on. A casting was observed marked 1.5421. The figure 1 designated it as belonging to ship No. 1; the figure 5 in that particular place (but in no other) that it belonged to the machinery of the vessel, the figure 4 that it was a part of the main engine, the figure 2 that it was a part of the bed plate, and the figure 1 that it was a particular part of that bed plate. This number appears on the drawing of the part, on the pattern, on the casting and in the cost account. It will be the number of the similar part in every vessel that may be built, the whole number alone being changed. The plant will not be in operation a year before every man and boy in the ship yard will be sufficiently familiar with the code to direct every piece of metal that enters into a ship to its proper place on the ways. The decimal system used in this way can take care of a multiplicity of parts, which can be traced back, if necessary, through every department to the draughting room.

PERSONNEL OF THE MANAGEMENT.

Henry G. Morse, president and organizer of the company, is a native of Ohio. His technical education was obtained at the Rensselaer Polytechnic Institute, Troy, N. Y., from which he graduated in 1871. Immediately thereafter he entered the service of the Pennsylvania railroad under John A. Wilson, and was employed in the construction of the low grade division, having direct charge of the Long Point tunnel. In 1872-73 he was engineer and superintendent in charge of construction of the masonry and erection of two bridges over the Allegheny at Foxburg and Parker's

Landing. From 1873 to 1878 he was engineer for the Wrought Iron Bridge Co. of Canton, O. Then for nine years he was a partner in the Morse Bridge Co. of Youngstown, O. For another period of nine years he was president of the Edgemoor Bridge Works at Wilmington, Del., and then he was introduced to ship building, being president of the Harlan & Hollingsworth Co., Wilmington, from 1896 to 1898. Then he devoted his long experience to the plans of the New York Ship Building Co. From September, 1898, until January, 1899, he was engaged in designing the plant and examining locations for the works. During the month of February, 1899, he personally obtained full subscriptions to the stock of the company, and since March of that year he has been president of the company.

Capt. William G. Randle, who is treasurer and superintending captain of the company, was for years connected with the International Navigation Co., commanding and superintending the construction of ships of that company. More recently he was in command of the Paris and St. Louis, serving on the latter as second in command during the Spanish-American war, during which time he held the rank of commander in the United States navy. He resigned from command of the St. Louis in June, 1899, to become connected with the New York Ship Building Co.

The general manager is De Courcey May, a Baltimorean, of varied experiences. He was sent to Paris to prepare for the Ecole Centrale, but did not enter the school, going, instead, to Scotland just before the outbreak of the Franco-Prussian war. He was in the class of engineering in the University of Edinburgh and apprentice in the workshop of T. M. Tenant & Co., Leith. From there he went to the engineering department of Cunliffe & Dunlap, Port Glasgow, on the Clyde, and subsequently became inspector in the Fairfield company's yard, Govan, Glasgow. After about seven years abroad he returned to this country in 1876 and took charge of the office of G. D. Levitt, consulting engineer for Calumet & Hecla, Cambridge, Mass. He was assistant and superintendent for the I. P. Morris Co., Philadelphia, for ten years, and engineer of the Cataract Construction Co. at Niagara Falls, at the installation of its plant. Immediately prior to his engagement with the ship building company he was general manager of the Dickson Manufacturing Co., Scranton, Pa.

R. L. Newman, the general superintendent, was connected in an official capacity with several of the largest ship building and marine engineering establishments of England, before coming to America. In this country he was on the technical staff at the works of the Cramps, Philadelphia, during the construction of the New York, Columbia, Brooklyn, Minneapolis, Indiana, Massachusetts and Iowa, in addition to quite a little of their merchant work. After service with the Globe Iron Works Co. of Cleveland, of which he became general manager, he accepted his present position as general superintendent of the New York Ship Building Co.

The secretary of the company, George L. Brown, was from 1881 to 1889 with the Rochester Tumbler Co. in various clerical capacities; from 1890 to 1896, treasurer of the Hainesworth Steel Co. of Pittsburg, and from 1897 to 1899, secretary and treasurer of the Oliver and Snyder Steel Co. of Pittsburg. In May, 1899, he entered the service of the New York Ship Building Co.

Mr. Charles S. Hall, purchasing agent, was for a long time associated with the president, Mr. Morse, in the Morse Bridge Co. and the Edgemoor Bridge Co. The chief engineer, Luther D. Levekin, is from Cramps', where he was employed for ten years in the engineering department and recently as chief of the drawing room. Mr. William F. Gronan, civil engineer, was also long associated with Mr. Morse. He designed the Ferris wheel for the Chicago exposition and was bridge engineer for the Edgemoor Bridge Works for many years. He designed and supervised all the detail drawings for the buildings of the ship building company.

Dr. Francis Elgar of London, well known to naval architects all over the world, is one of the consulting engineers of the company. Other engineers engaged in a consulting capacity are Julian Kennedy of Pittsburg, eminent in mechanical lines, and Dr. W. L. Robb of Hartford, Conn., who has had wide experience in electrical engineering connected with power plants and government work.

CURVE OF STABILITY.

Editor Marine Review: The importance of the subject dealt with by Mr. Cook in his article in the last issue of the Review can not be overestimated, and the Scottish practice for rapid approximation of the curve of stability is certainly very interesting. What struck me most was the adoption of the angle of 57.3° for the erection of the perpendicular equal to the M G of the upright condition. Perhaps Mr. Cook can explain why this angle is chosen for all ships and give a reason for its correctness. The finding of the tangent to the curve at 90° seems like spending time that might be better employed for another intermediate spot.

Such rapid methods deserve attention, as so little has been done as yet in this direction, and so much can be gained if only the cost and time can be kept down. The ship designing fraternity is certainly indebted to the Marine Review and to Mr. Cook for bringing these valuable considerations to the front. I hope my inquiry may seem interesting to you and your readers.

Theodore Lucas.

New York, 97 Water street.

It is announced in Washington that Secretary Long has decided to take no action on the board of awards' recommendation of a design for the West Indian battle medal until the return to Washington next week of Assistant Secretary Hackett, the chairman of the board. The medal bears on one side a profile likeness of Rear Admiral William T. Sampson, commander-in-chief of the United States fleet in the West Indies in the war with Spain. On the reverse is a representation of a naval battle, with a vessel of the Oregon type in the foreground. The board has not recommended a medal for conspicuous service during the war performed other than in battle, but will probably do so, as otherwise some officers who acted as scouts, risking their lives to obtain information, would have nothing to show for their daring.

Rear Admiral George Wallace Melville, chief of the bureau of steam engineering, navy department, has returned to Washington from the Pacific coast where he attended the launching of the battleship Ohio and afterwards visited Portland and Seattle.

OFFICIAL REPORTS ON ERIE-TASHMOO CONTEST.

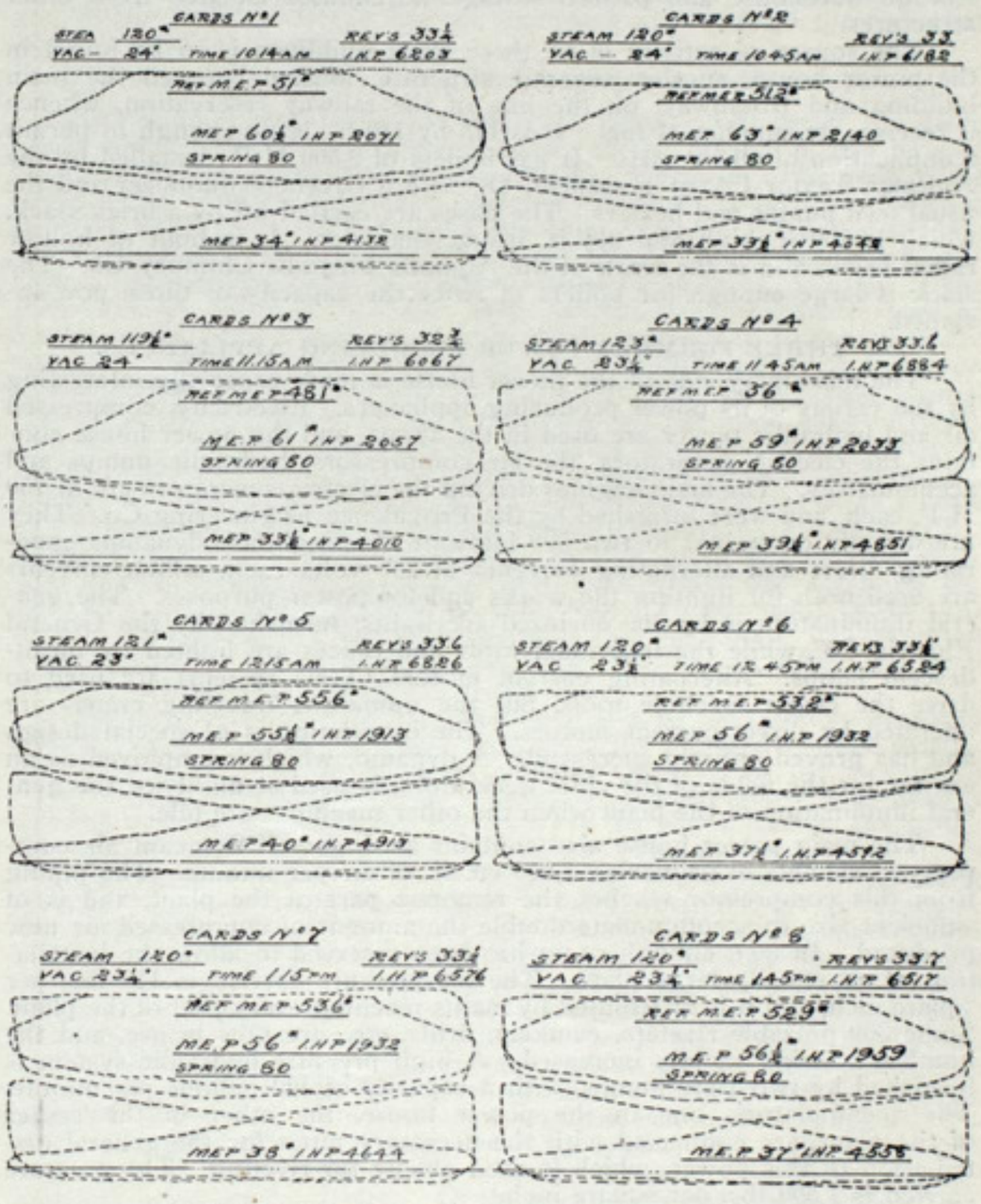
Mr. C. B. Calder and Mr. George Mattsson, engineers of the Detroit Ship Building Co., have favored the Review with data taken aboard the side-wheel steamers City of Erie and Tashmoo during the race on June 4 on Lake Erie, between Cleveland and Erie, which resulted in a victory for the Erie by the small margin of only 45 seconds in a run of 94 miles. As both vessels were built by the Detroit Ship Building Co., and as one great feature of value in the contest was the opportunity afforded to obtain reliable information from a ship building standpoint, it follows that the reports of these two experts are facts; that there could be no object in favoring either vessel as to results. It will be noted in this connection that although the speed of the winning ship was said to have been a little in excess of 22 miles an hour, the official reports show only 21.7635 miles per hour for the Erie as against 21.7032 for the Tashmoo, a difference of only six-hundredths of a mile. In revolutions per minute and in horse power developed both vessels exceeded all expectations. The average revolutions for the Erie was 33.36 and for the Tashmoo 40.08. The Erie attained a maximum of 6,884 H.P. The average horse power was 6,472 for the Erie and 3,400 for the Tashmoo. Following are the results, supplemented by interesting cards from the engines:

DATA TAKEN BY MR. C. B. CALDER ON STEAMER CITY OF ERIE.

Hull—Built of steel; 324 ft. over all; 314 ft. keel; 44 ft. beam; 77 ft. 2½ in. over guards; 18 ft. deep; all moulded.

Draught—Forward, 9 ft. 9 in.; aft, 10 ft. 10 in. mean, 10 ft. 3½ in.

Displacement—2,500 net tons; 2,233 gross tons; wetted surface, 12,776 sq. ft.



CITY OF ERIE—CARDS TAKEN IN RACE WITH TASHMOO.

Prismatic coefficient, .603; ratio of length to beam on water line, 7.136.

Engine—Compound beam type; H.P. cylinder 52 in. diameter by 96 in. stroke; low pressure cylinder 80 in. diameter by 144 in. stroke; air pump 52 in. diameter by 45 in. stroke; feed pump 16 in., 11 in., 14 in., simplex; pony pump 14 in., 8 in., 10 in.

Boilers—Six cylindrical of 12 ft. 6 in. diameter and 11 ft. 9 in. over all; Howden hot draft; 130 lbs. working pressure; two furnaces in each boiler, 46 in. diameter; grate, 5 ft. 6 in. long; total heating surface, 11,580 sq. ft.; total grate surface, 252 sq. ft.; ratio, 46 to 1; two blowers of 66 in. wheel diameter and 34x34 in. discharge with engine of 7x7 in.

Heater—25 in. diameter; 10 ft. 2 in. over all; ninety-five 1½-in. tubes of 8 ft. length; 302 sq. ft. heating surface.

Wheels—Diameter over buckets, 28 ft. 6 in.; diameter over trunions, 25 ft. 2 in.; eleven buckets, 4 ft. wide and 12 ft. long; dip, 5 ft. 2 in.

	Minimum.	Average.	Maximum.
Steam pressure, lbs.	119.5	120.4	123.
Vacuum, in.	24.	23.5	23.25
Air pressure, in.	.....	.....	5.
Revolutions per min.	32.75	33.25	33.6
M. E. P., high pressure cyl., lbs.	61.	58.4	59.
M. E. P., low pressure cyl., lbs.	33.5	36.6	39.5
M. E. P., ref. to L. P. cyl., lbs.	48.1	53.07	56.
I.H.P. high pressure cyl.	2057.	2004.6	2033.
I.H.P., low pressure cyl.	4010.	4467.7	4851.
Total I.H.P.	6067.	6472.3	6884.

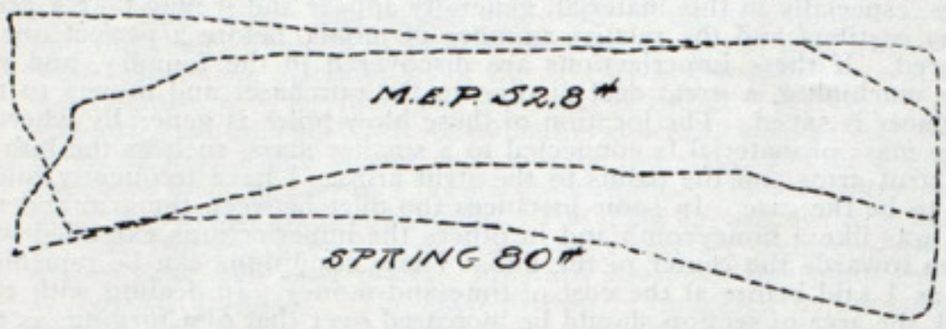
I.H.P. per square foot of grate surface, 25.68.
I.H.P. per square foot of heating surface, 1.789.
I.H.P. per net ton of displacement, 2.5888.

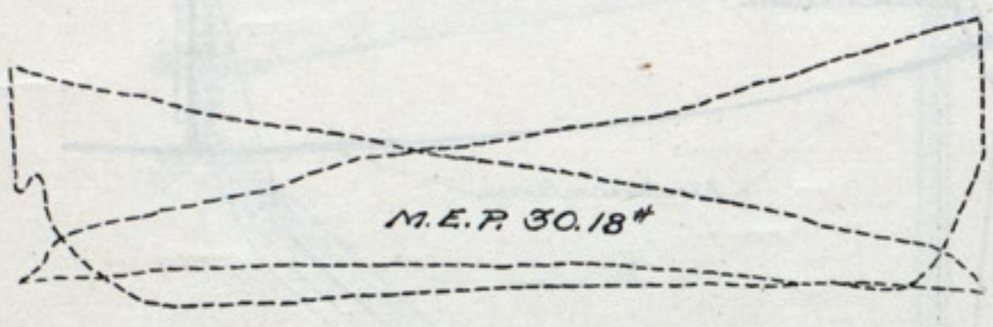
I.H.P. per gross ton of displacement, 2,898.
I.H.P. per 100 ft. of wetted surface, 50.66.
Total distance, 94 miles.
Total number of revolutions, 8,618.
Official time, 4 hrs. 19 min. 9 sec.
Miles and knots per hour, 21.7635 miles, 18.899 knots.
Speed of wheel, 33.82 miles.
Slip of wheel over bucket, 35.65 per cent.
Wind—Five miles per hour; N. E., light, ahead; end of race, calm.
Depth of water in fathoms—At start, 9; minimum, 7; maximum, 12; average, 10.

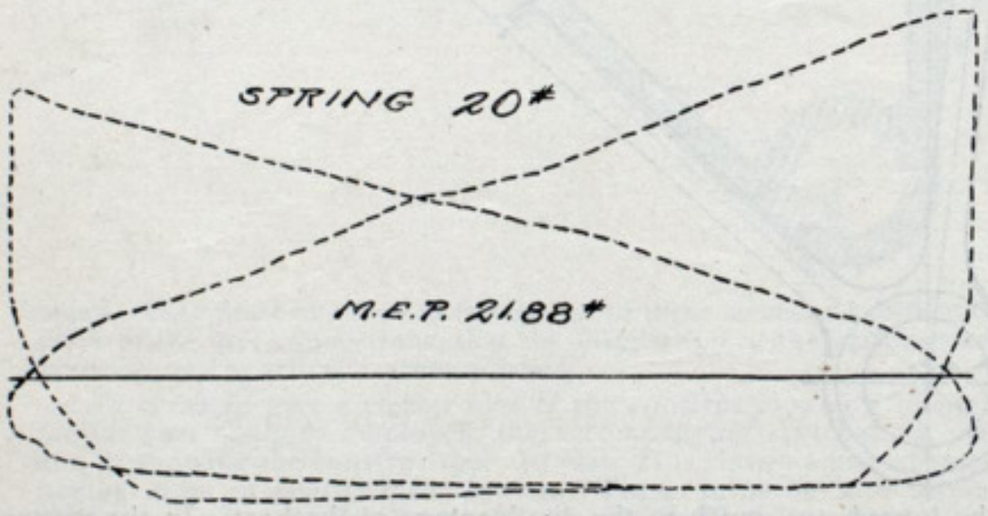
$$C=\frac{D^{2/3}xS^3}{I.H.P.}=\frac{2233\frac{2}{3}x18\,9^3}{6472}=178.2$$

DATA TAKEN BY MR. A. GEO. MATTSSON ON STEAMER TASHMOO.

Hull—Built of steel; 308 ft. over all; 300 ft. keel; 37 ft. 6 in. beam; 69 ft. over guards; 13 ft. 6 in. deep; all moulded.
Draught—Forward, 8 ft. 1½ in.; aft, 8 ft. 5½ in.; mean, 8 ft. 3½ in.
Displacement—1,370 tons net; 1,224 tons gross; wetted surface, 8,976 sq. ft.
Prismatic coefficent, .584; ratio of length to beam on water line, 8.







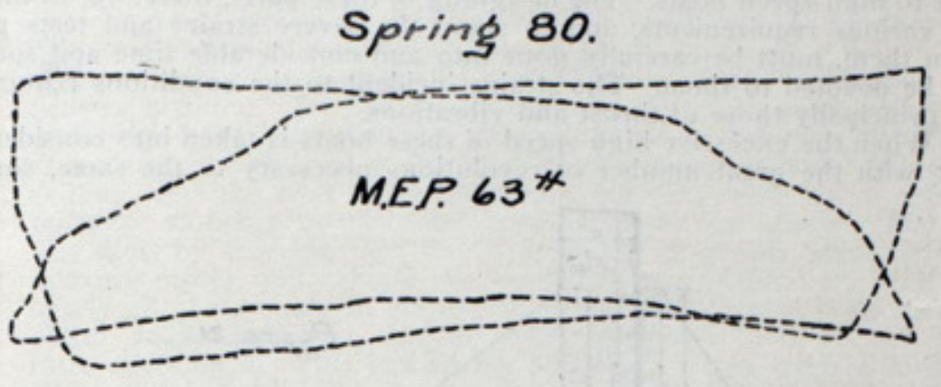
STEAMER TASHMOO—CARDS TAKEN MAY 30, 1901.

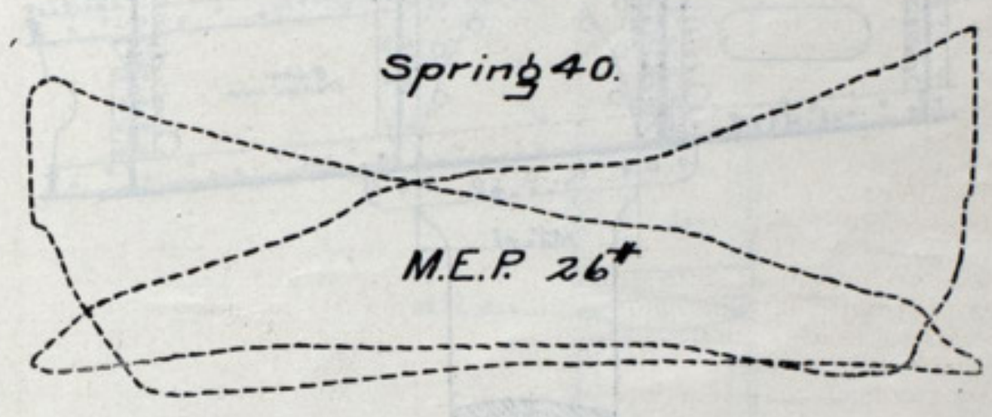
Boiler press., 175 lbs.; vacuum, 22 in.; rev. 39; I. H. P.-H. P., 639; I. H. P.-Int., 876; I. H. P.-L. P., 1,635; total I. H. P., 3,150; R. M. P., 42 lbs.

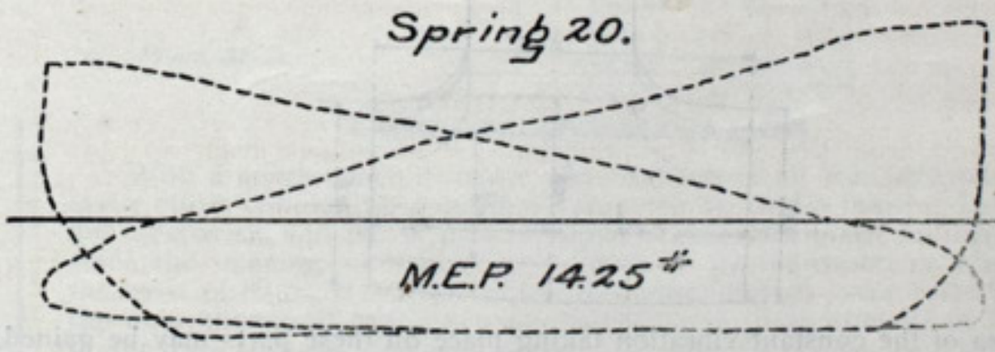
Engine—Inclined triple expansion; H.P. cylinder, 33 in. diameter; I.P. cylinder, 51 in.; L.P. cylinder, 82 in.; common stroke, 72 in.; air pump, 45 in. diameter by 24 in. stroke; feed pump, 14, 8 and 12 in., simplex; fire pump, 10, 6 and 10 in., duplex.
Boilers—Five of cylindrical type; three single-ended of 11 ft. 1 in. diameter by 11 ft. 4 in. over all, with two furnaces in each; two double-ended of 11 ft. 1 in. diameter and 22 ft. length over all, with four furnaces in each; all furnaces 42 in. diameter; grate 6 ft. long; working pressure, 170 lbs.; total heating surface, 8,750 sq. ft.; total grate surface, 294 sq. ft.; ratio, 29.76 to 1.
Heater—25 in. diameter by 9 ft. 6 in. over all; 103 1½-in. tubes of 7 ft. length; 282 sq. ft. heating surface.
Wheels—Diameter over buckets, 22 ft. 5 in.; diameter over trunions, 19 ft. 1 in.; nine buckets, 3 ft. 9 in. wide by 12 ft. long; dip, 4 ft. 9 in.
Steam pressure (L. P. pass-over valve half open during last 1½ hours), 175 lbs.
Vacuum, 22 in.
Revolutions per minute (39.61 for 3 hours, 27½ minutes; 40.73 for 52 minutes, 24 seconds), 40.08.
I.H.P., average, 3,400.
I.H.P. per square foot of grate surface, 11.58.
I.H.P. per square foot of heating surface, 2.57.
I.H.P. per net ton of displacement, 2.48.
I.H.P. per gross ton of displacement, 2.77.
I.H.P. per 100 ft. of wetted surface, 39.1.
Total distance, 94 miles.
Total revolutions, 10,354.
Official time, 4 hours, 19 minutes, 54 seconds.
Miles and knots per hour, 21.7032 miles, 18.847 knots.
Speed of wheel, 32 miles.
Slip of wheel over bucket, 32.2 per cent.
Wind—Five miles an hour; N. E., light, ahead; end of race, calm.
Depth of water in fathoms—At start, 9; minimum, 7; maximum, 12; average, 10.

$$C=\frac{D^{2/3}xS^3}{I\,H.P.}=\frac{1224\frac{2}{3}x18.847^3}{3400}=225$$

Referring in conversation to the performance of the Tashmoo, Mr. Mattsson said: "We feel no disappointment in regard to machinery of







STEAMER TASHMOO—CARDS TAKEN JUNE 14, 1900.

Boiler press., 150 lbs.; vacuum, 22 in.; rev., 35; 1st recv., 45 lbs.; 2nd recv., 13½ lbs.; I. H. P.-H. P., 685; I. H. P.-Int., 685; I. H. P.-L. P., 960; total I. H. P., 2,330; R. M. P., 33.6 lbs.; draft, 7 ft. 6 in. for'd, 8 ft. 10 in. aft.

the Tashmoo, as the engines worked to perfection all around and the horse power developed was very much beyond our expectations. Instead of the thirty-eight revolutions looked for before the contest we got an average of forty (corresponding to 3,400 H.P.) The point of special interest to us during the run was the condensing apparatus, but even when applying to low-pressure cylinder pass-over in the struggle of the last hour we had 21½ in. vacuum and held it, with the assistance of ice and cold water used freely externally on the condenser. The condenser was not, however, hot at any time and there was nothing in the stories that were printed on that score. We simply got all the power out of the machinery that was in it, and everybody did his duty and did it well."

A contract for the construction of a new steamer to replace the Druid, for which the Canadian government recently advertised, has been awarded to Flemming & Ferguson, Paisley, Scotland, at $110,960. The lowest Canadian tender was about $60,000 higher than the successful bidders. The new steamer will be 160 ft. long, 30 ft. wide and 13 ft. deep.

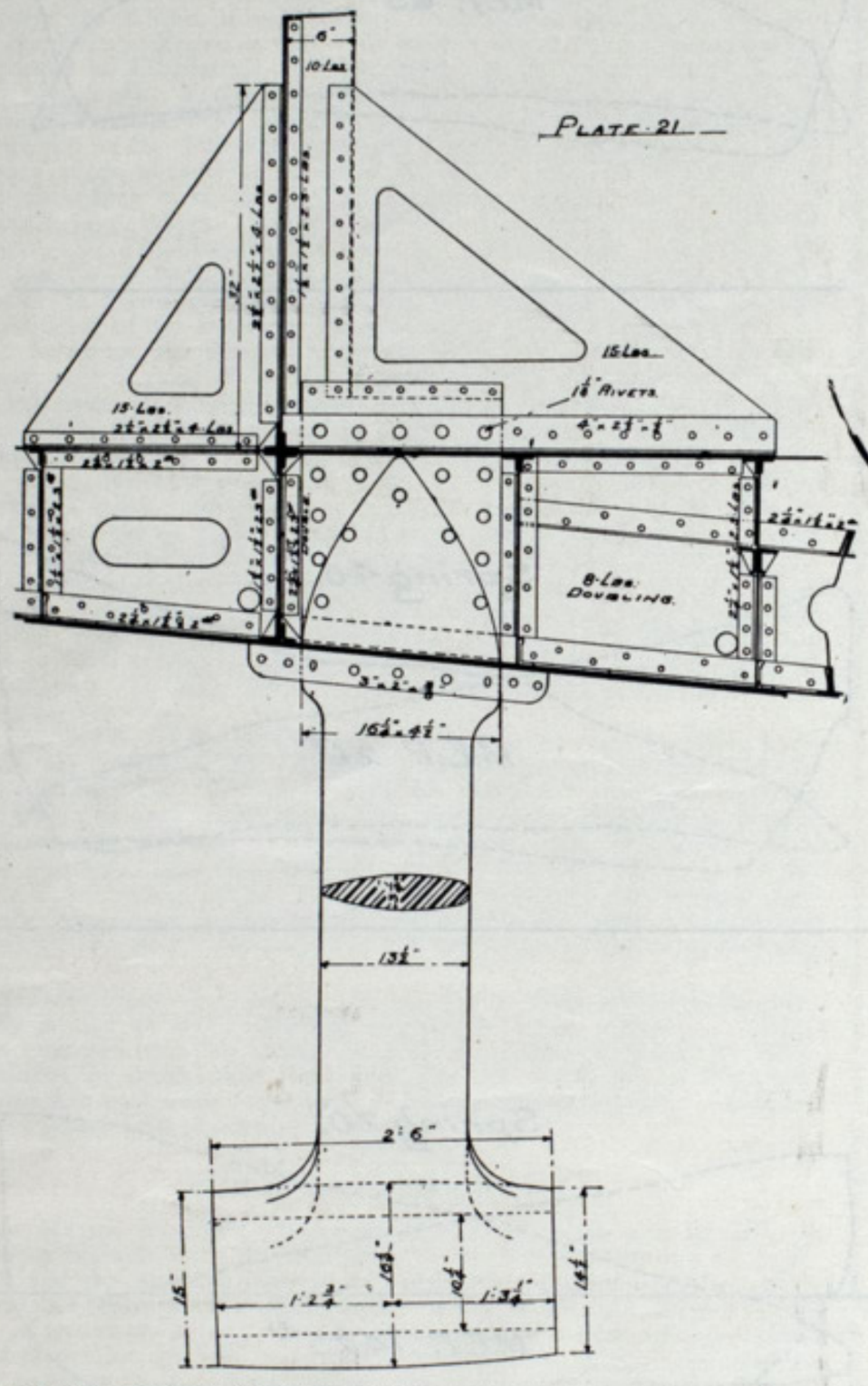
CONSTRUCTION OF TORPEDO BOATS AND DESTROYERS.

BY GEORGE HERBERT WILSON.

PROPELLER STRUTS.

The rudder applinaces having been well outlined and the steering details gone into, I will now turn to those important parts of the propelling machinery, the propeller struts and shaft hangers. The great dependence placed upon these parts when the boat is under way demands that they be so constructed and so connected as to withstand the severe strains put upon them. In addition to these requirements they must be brought down to the minimum of weight, and the connections to and through the shell must be perfectly water-tight under the conditions incident to high-speed boats. The designing of these parts, therefore, to meet the various requirements, and to stand the severe strains and tests put upon them, must be carefully gone into and considerable time and space can be devoted to them. The strains incident to the conditions required are principally those of thrust and vibrations.

When the excessive high speed of these boats is taken into consideration, with the great number of revolutions necessary to the same, some



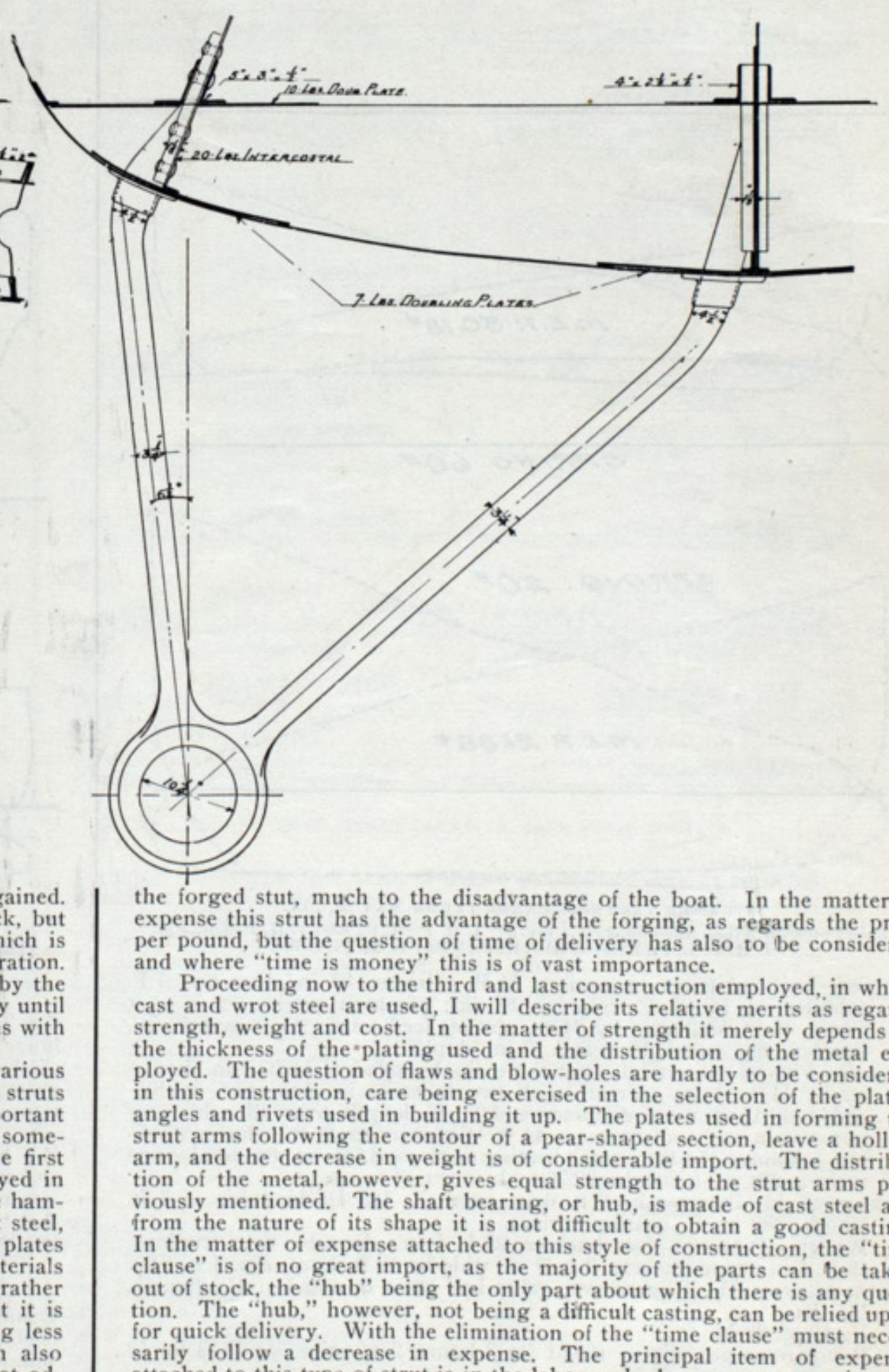
idea of the constant vibration taking place on these parts may be gained. The thrust of the propeller is, of course, taken up at the thrust block, but there is a certain amount of thrust in the transverse direction which is constant and varying in locality, being the principal cause of this vibration. The weight of the shafting and the propellers is, of course, carried by the strut, and this weight increases in moment as the vibrations multiply until it reaches a maximum, at which point the strut must resist the strains with a considerable factor of safety.

In outlining the different constructions employed and the various types adapted, I will take them separately, dealing with the propeller struts first and the shaft hangers later. The propeller strut, the more important of the two, takes its name from its nearness to the propeller, but is sometimes known as a shaft strut, as that is its principal function. The first and principal matter for consideration is the material to be employed in the construction of the strut. The general practice has been to use hammered scrap iron, but of late there has been a tendency to use cast steel, and this practice has again been followed by using a strut built up of plates and bars, carrying the hub casting. As regards these different materials the first has the advantage of being very strong and rigid, but rather heavy and very expensive. The second has sufficient strength, but it is gained at the expense of weight; it has also the advantage of being less expensive. The third is built up to the required strength, which also brings up the expense to about that of the first, but it has the great advantage of being lighter than either of the two.

Dividing the question of material into three headings, namely strength, weight and cost, I will deal with each separately to a certain extent. In deciding the relative properties of the materials generally employed, it is a well known fact that great dependence is to be placed in hammered scrap iron, but the difficulty in forging such a shape as a strut and making the proper welds creates a certain amount of doubt as to the presence of flaws and other imperfections. With a perfect forging, however, a more satisfactory piece of work could hardly be desired.

The question of weight in these fittings is of very great importance, coming as they do at so great a distance abaft the center of flotation, and having a tendency to trim the boat by the stern. In a forging the shape and size of the average strut a great deal of weight is necessarily entailed and some of this weight could be dispensed with, as will be shown, in another method. To gain the best effects of a forged strut as regards material, the expense of a good forging is relatively high and the price has a great tendency to fluctuate, while delivery of such goods is a questionable item. The past demand for forgings of all descriptions, combined with the high price of iron, are examples of what may be expected at any time.

In dealing with the next material, cast steel, a different proposition is at hand. Owing to the shape of the casting there are places where blow-holes, especially in this material, generally appear and it may take a great many castings and the relative number of molds, before a perfect one is secured. If these imperfections are discovered in the foundry, and not after machining, a great deal of time to the purchaser and money to the producer is saved. The location of these blow-holes is generally where a large mass of material is connected to a smaller mass, such as the hub to the strut arms and the palms to the strut arms. I have frequently found this to be the case. In some instances the fillet between the arm and the hub was like a honeycomb and in others the imperfections extended well down towards the center of the hub. These conditions can be remedied, but as I said before at the cost of time and money. In dealing with cast steel, the area of section should be increased over that of a forging, as the factor of safety is less. This naturally increases the weight over that of



the forged stut, much to the disadvantage of the boat. In the matter of expense this strut has the advantage of the forging, as regards the price per pound, but the question of time of delivery has also to be considered and where "time is money" this is of vast importance.

Proceeding now to the third and last construction employed, in which cast and wrot steel are used, I will describe its relative merits as regards strength, weight and cost. In the matter of strength it merely depends on the thickness of the plating used and the distribution of the metal employed. The question of flaws and blow-holes are hardly to be considered in this construction, care being exercised in the selection of the plates, angles and rivets used in building it up. The plates used in forming the strut arms following the contour of a pear-shaped section, leave a hollow arm, and the decrease in weight is of considerable import. The distribution of the metal, however, gives equal strength to the strut arms previously mentioned. The shaft bearing, or hub, is made of cast steel and from the nature of its shape it is not difficult to obtain a good casting. In the matter of expense attached to this style of construction, the "time clause" is of no great import, as the majority of the parts can be taken out of stock, the "hub" being the only part about which there is any question. The "hub," however, not being a difficult casting, can be relied upon for quick delivery. With the elimination of the "time clause" must necessarily follow a decrease in expense. The principal item of expense attached to this type of strut is in the labor and where a proper equipment of tools is at hand this can be reduced to a minimum. Taking labor and material into consideration it still remains for this type of strut to lead the others in cheapness, especially where the demand for forging and castings is great.

The question of making a water-tight connection where the strut pierces the structure demands considerable attention and is still the bone

of contention among some practical men. This question also covers the inside connections and should be carefully considered with the foregoing as they are each dependent upon the other. In the majority of cases, that is in the present practice, the arms of the strut go through the shell of the boat and the palms are secured to a longitudinal, built specially for the purpose. In some of the earlier boats the palm was secured to a heavy doubling plate on the shell, well stiffened on the inside. This practice has been abandoned of late on account of the difficulty in securing a permanent water-tight connection and on account of a stronger job being effected in the other method. In the old practice the rivets through the palms and the shell were found to loosen up and destroy the water-tight effect. Where the arms of the struts enter the hull a doubling plate is located and a strong angle collar is fitted around the arm. This is well packed, riveted and caulked, making it perfectly water-tight. The vibration of the parts in connection at this point has very little effect on this collar, as, from its shape, it forms a very rigid connection, and is carried along with the vibrating parts.

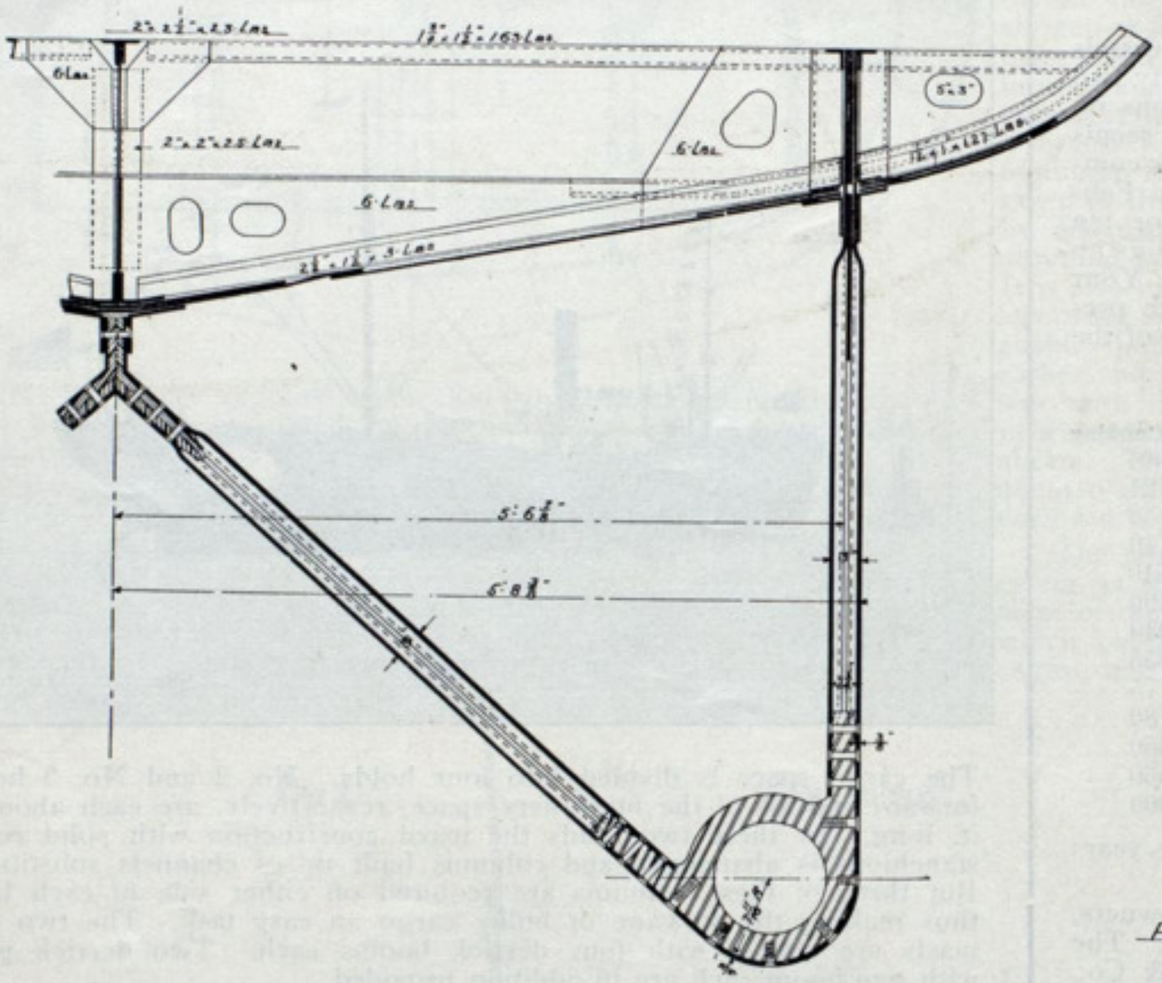
The stiffening provided in the wake of this strut is of considerable importance and the distribution of the enormous strain, caused by the propelling power, is dependent upon a properly built structure in the vicinity. The general practice is to make the two frames on either side of the struts of the "belt" type. The weight and depth of the floor plates are increased and the "belt" frame is carried all the way up and around under the deck. This insures the distribution of the strains in the transverse direction in combination with the increased thickness of the shell plating. In the fore-and-aft direction a special longitudinal is generally worked, extending over three or four frame spaces each side of the strut, and in a great many instances forming part of a regular longitudinal. This longitudinal is built up of intercostal plates and angles. The plate abreast of the strut, between the belt frames, is made very heavy and is rigidly connected to the floor plates, shell, and rider plates. Forward and abaft this point the strength is reduced gradually. The shell plating is increased in thickness in this locality, and in the wake of the arms of the strut doubling plates are provided. Care must be taken in the design of these struts and in the arrangement of the hull connections, that the installation of the various parts can be easily and practically accomplished.

In order to give a clearer idea of the constructions now in use I will outline two methods employed, the accompanying sketches on plates 21 and 22 showing the construction. In plate 21 is shown a forged steel strut, having arms of pear-shaped section. These arms lie in a fore-and-aft plane so as to cause the least resistance. The "hub" or bearing is made of sufficient length to afford a good bearing for the shaft. The arms of the strut end in large rectangular palms. The size of these palms is dependent upon the number of rivets necessary and the stiffness required. The longitudinal strengthening is well outlined and shows the great dependence to be placed upon it. The expensiveness of such a strut when the shape and nature of the forging, and the metal, is considered is readily seen and the delay in obtaining a forging of this nature can be appreciated. For use in comparison it may be noted that the weight of the strut alone, exclusive of bushings and bearings, is 2,734 lbs. Had the material used been cast steel instead of foregoing, the general outline and hull connections would have been the same. The only difference would be in the section of the arm which should be increased to bring up the strength. This naturally involves an increase in weight and brings the expense nearly up to the foregoing type, especially if difficulty is found in securing a good casting.

From these I will turn to the built-up strut and endeavor to outline some good points. The detail of this strut, shown in plate 22, will give a fair idea of the method employed and the hull connections. It will be seen that the strut is built up of four main plates and the "hub" or bearing casting. The "hub" was made of cast steel, which from its simple shape was an easy casting to make. No difficulty whatever was experienced in this respect. The two plates forming the arms of the strut were dished so as to bring up the strength and secure stiffness. A flat bar, riveted between these two plates on each edge, completed the arm construction and made a very strong hollow arm section. The outboard plates are carried around under the "hub," to which they are secured by means of through rivets and tap rivets. The connections through and to the hull are made in a different manner on each arm. The inboard arm does not pass through the shell, but is secured to it by means of large angles, which are attached to large flanged plates, extending over three frame spaces and down into the arm of the strut, to which they are well secured by through rivets. The section of the strut at the center of the boat will show this construction.

In the outboard arm a different plan has been followed. The two plates forming the arm are carried up through the shell plating to the top of the floors. Between these plates, outside of the shell, a long bracket plate is worked, extending over three frame spaces and rigidly secured to the shell plating by a large angle collar, which also provided for water-tightness. On the inside of the shell the local longitudinal passed between these two plates, to which they were well secured by rivets. Extra strengthening was gained by angle clips to the shell, floors and steel deck. The longitudinal in the wake of the outboard palm and the keel in the wake of the inboard provide for the fore-and-aft stiffness. The advantages of this type of strut over those previously mentioned are lightness, cheapness and ability to secure the strut in place at an earlier date. The first of the advantages is readily seen by the hollow arms. The second by inexpensive material. The labor, of course, counts as the most expensive item under this head. Considerable time was saved by having a die cast for the arm plates, and the rest of the forge work was very simple. Erection and drilling were the next important items, but they were not of enough importance to bring up the total expense above the others. The erection was done by securing the "hub" casting in its proper place by bars and distance pieces, and around the "hub" the arm plates were built up. As nearly all of the material employed in this construction is in the shape of plates, angles and bars, and all stock sizes, the "time clause" can have little effect on it. This can hardly be said of a cast steel or forged strut. The weight of this last type of strut, the "built up" type, was 2,050 lbs., a saving of about 700 lbs. over the other type.

From all the considerations and discusssion of these constructions it follows that when properly designed the "built up" strut has the advantage over other types.



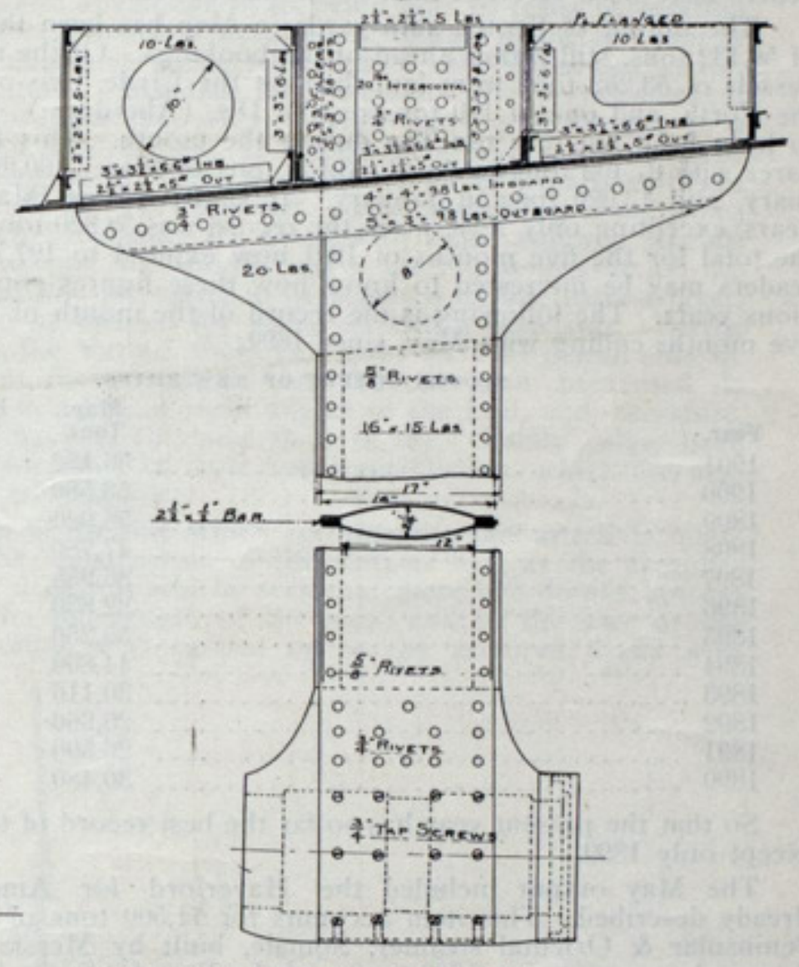


PLATE 22

LAKE FREIGHT SITUATION.

With a continuance of heavy consumption in all iron and steel lines, every effort is being made to move iron ore up to the limit of Lake Erie dock capacity, and the freight situation is thus practically as it has been since the opening of navigation. There is no indication of change in the basis of 80 cents freight on ore from the head of Lake Superior, and the only change in coal since the opening is a drop from 40 to 35 cents in the rate to Lake Superior ports, due entirely to the fact that more vessels are going to Lake Superior for ore than are going to Lake Michigan. Thus there is a shortage in coal carriers for Lake Michigan equivalent to the surplus for Lake Superior.

Reports dealing with ore shipments to June 1 show a total somewhat in excess of what was looked for by the vessel owners. It was expected that the movement would be little in excess of a million tons, as against more than three times that amount on June 1 a year ago. The figures are 1,689,775 tons to June 1, 1901, compared with 3,265,888 tons to June 1, 1900.

TRIAL TRIP OF BATTLESHIP ILLINOIS.

The battleship Illinois, built by the Newport News Ship Building & Dry Dock Co., Newport News, Va., had her official trial over the government course from Cape Ann to Cape Porpoise and return, a distance of 66 nautical miles, on Wednesday of this week, and maintained a mean speed of 17.31 knots for four consecutive hours. Steadiness and reserve power characterized the performance of the ship throughout the severe test. The work of her engines was smooth and even and the records of a day showed but one-tenth of a knot difference in speed between the northern run and the return. The maximum speed—attained twice during the trial—was 17.84 knots. The ship described a complete circle within 300 yards, or little more than twice her length, in three minutes and three seconds, while ploughing through the sea at full speed.

SHIP BUILDING ON THE CLYDE.

THE INDUSTRY STILL SHOWS MORE ACTIVITY THAN WAS EXPECTED A SHORT TIME AGO—MODERATE PRICES BUT NOT THE LOWEST KNOWN.

[Special correspondence to the Marine Review.]

Glasgow, Scotland, June 2.—The ship building industry has resumed rather a better appearance during the month which is just ending. If the "promise of May" is fulfilled our ship builders will have by no means a bad year, though so far as I can learn the yards in the English building districts are not quite so well favored. A number of new and important contracts have been placed during the last few weeks, although not all have been reported, nor (for business reasons) are all even admitted by the recipients. For instance, the Fairfield Ship Building & Engineering Co. has booked a couple of large boats for the Pacific Steam Navigation Co. Messrs. Murdock & Murray are to build a 2,000-ton cargo boat for the continent and an 800-ton boat for Ireland. Three good sized cargo boats are to be built by Messrs. Russell & Co., Port Glasgow, for Liverpool owners. A new Cunarder is to be built at Clydebank by John Brown & Co., Ltd., who have also contracted for two large steamers for the Australian trade. Messrs. D. & W. Henderson & Co., Glasgow, are said to have secured an order for two large steamers for the China Mutual Steam Navigation Co. Another Peninsular & Oriental liner is to be built by Messrs. Barclay, Curle & Co. Messrs. Charles Connell & Co., Whiteinch, are credited with having received an order for a new "Harrison" liner. Messrs. Hall, Russell & Co., Aberdeen, are to build a 7,000-ton cargo boat for Aberdeen owners. Messrs. Gourlay Bros. & Co., Dundee, have contracted for a 1,000-ton steamer for the Australasian Steam Navigation Co., and sundry orders for small craft, dredgers, etc., have been booked by other builders. Altogether the new orders for the month cannot be less than 50,000 tons, and may be a good deal more, as the size of the vessel has not always been revealed, and probably a good many more orders have been received than those mentioned.

The output of Scotch ship yards in May has been thirty-five vessels of 56,132 tons, still rather ahead of the bookings. Of the total, thirty-two vessels of 53,252 tons were launched on the Clyde, two of 2,700 tons on the Forth, and one of 180 tons on the Dee (Aberdeen.) Nothing seems to have been put into the Tay during the month. This May total compares with 27,462 tons in April, 33,430 tons in March, 60,000 tons in February, and 13,020 tons in January. It is the largest May total for ten years, excepting only 1899, when the record was 58,920 tons. It brings up the total for the five months of 1901 now expired to 197,724 tons. Your readers may be interested to know how these figures compare with previous years. The following is the record of the month of May and of the five months ending with May, since 1890:

SCOTCH OUTPUT OF NEW SHIPS.

Year.	May. Tons.	Five months ending with May.
1901	56,132	199,724
1900	53,580	180,056
1899	58,920	217,740
1898	47,780	176,540
1897	36,955	127,490
1896	32,830	172,940
1895	55,250	146,355
1894	44,800	142,775
1893	30,116	104,780
1892	26,966	172,460
1891	26,590	147,530
1890	30,480	176,000

So that the present year has so far the best record of the twelve years except only 1899.

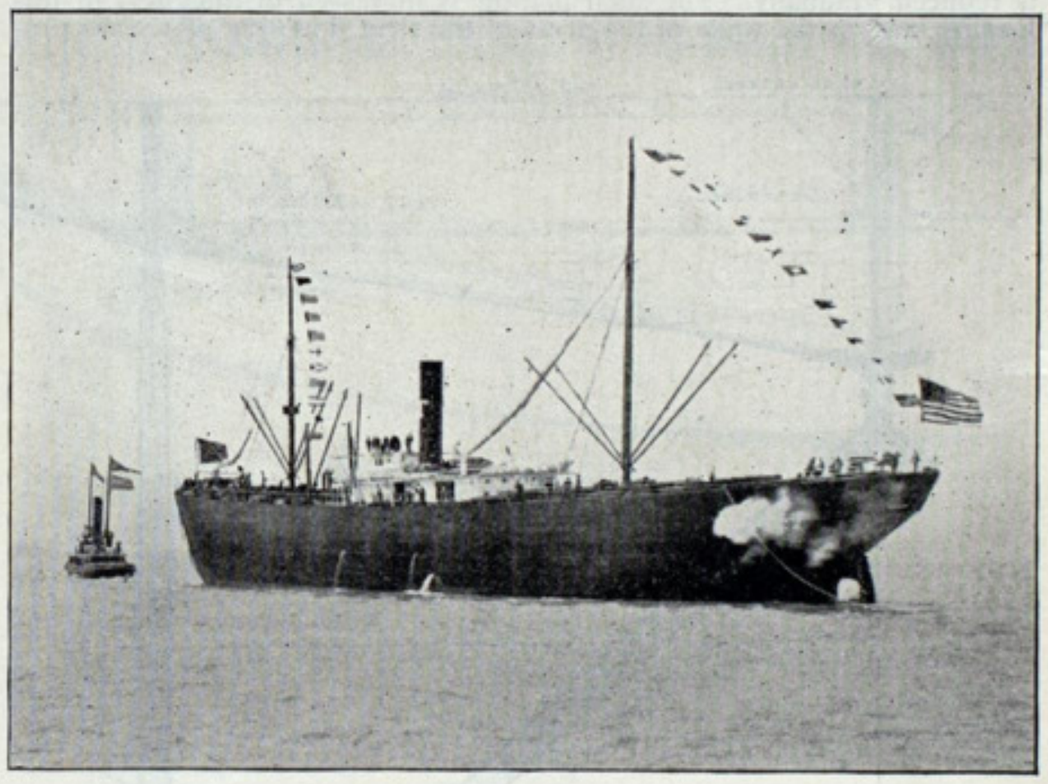
The May output included the Haverford for American owners, already described. This item accounts for 11,500 tons of the total. The Peninsular & Oriental steamer, Somale, built by Messrs. Caird & Co., Greenock, accounts for 6,700 tons, and the P. & O. Syria, built by Messrs. Alexander Stephen & Sons, accounts for the other 5,000 tons. Among other notable items of the month may be named the Gordon Castle, a 4,750-ton screw of 2,500 I.H.P., built by Messrs. Charles Connell & Co., for the Union-Castle (South African) line; the Perugia, a 4,500-ton boat, built by Messrs. D. & W. Henderson & Co. for the Mediterranean and New York service of the Anchor line; the Baltico, a 3,600-ton screw of 1,500 I.H.P., built by Messrs. Russell & Co., Port Glasgow, for Greek owners; the Eretria, a 3,500-ton boat of 1,500 I.H.P., built by Messrs. Kincaid & Co., Greenock, for Messrs. William Thompson & Co., St. John, New Brunswick; the Dorisbrook, a 2,500-ton boat by Messrs. A. Rodgers & Co., Port Glasgow, for Glasgow owners; the Moira, a 2,200-ton boat, built by Messrs. William Denny & Bros., Dumbarton, for the Australasian Steam Navigation Co.; the Tamaulipas, built by Messrs. A. McMillan & Co., Dumbarton, for the Compania Vapores Correros de Romano, Mexico. There were several other cargo boats of smaller size, as well as a twin screw with surface condensing engines of 300 I.H.P., built by Messrs. David J. Dunlop & Co., Port Glasgow, for service on the river Niger, West Africa; a number of steam and sailing yachts; a couple of dredges for foreign countries, built by Messrs. Lobnitz & Co., Renfrew; and some steam fishing boats (trawlers) and stern-wheel river boats. It will be seen that the output has been a very miscellaneous collection, fairly illustrating the varied character of the Clyde ship building trade. Amongst the items, the most notable is, of course, the turbine steamer King Edward, referred to in previous letter, which begins active work on the Clyde within the next two or three weeks.

It is believed that a good many orders will have to be placed during the summer by the great steamship companies, who must keep up their lines, whatever may be the cost, and however bad may be freight and trade prospects. But in the present state of the freight market and with evidences of a decline in the volume of commerce all over the world, there is not much encouragement for the building of cargo "tramps." The large sales of second-hand boats of this class to foreigners have tended to bring down freights on British owners, because these vessels can be, and are, run much more cheaply under a foreign than under the British flag, and they cut into the ocean traffic in all directions. What they have thus sold, however, British owners can now replace at a handsome profit, for steel ship plates are now obtainable at a good deal under £6 per ton. Of course plates are not everything, and wages and other material are still a good deal above the rates current a few years ago, but nevertheless steamers can now be built at a moderate price, although not at the lowest price known.

DESCRIPTION OF THE STEAMER LYRA.

Sparrow's Point, Md., June 12.—The steamship Lyra, latest product of the marine department of the Maryland Steel Co., has just been delivered to its owners, the Boston Tow Boat Co. This is the third cargo ship the Maryland Steel Co. has built for the Boston company within the past two years, the first two—sister ships—the Pleiades and Hyades, having attracted considerable attention as very successful examples of the ocean tramp. The Lyra is in many respects, especially in her engineering equipment, a duplicate of the Pleiades and Hyades, but whereas the latter were designed primarily as colliers, the former is built to meet the demands of the general trade. Principal dimensions and other particulars are: Length between perpendiculars, 330 ft. 6 in.; length over all, 350 ft.; beam, molded, 47 ft.; depth, molded to shelter deck, 35 ft. 6 in.; net tonnage, 3,516; gross tonnage, 4,417; total cargo capacity, 315,372 cu. ft.; deadweight carrying capacity, including coal on 24 ft. 3 in. draught, 6,300 tons; coal bunker capacity, 633 tons; official number, 141716; official letters, K. Q. V. F.

The framing of the Lyra is of channels and deep webs, cellular double bottom from the forward peak to the after peak tank with floors on every frame. The double bottom is 40 in. deep, and with the peak tanks the water ballast capacity is 1,152 tons. She has three complete steel decks, lower, main and shelter. Amidships on the latter is a commodious steel deck house for officers' quarters with a pilot and chart house above.



The cargo space is divided into four holds. No. 2 and No. 3 holds, forward and aft of the machinery space, respectively, are each about 75 ft. long. In these two holds the usual construction with solid round stanchions is abandoned and columns built up of channels substituted. But three of these columns are required on either side of each hold, thus making the stowage of bulky cargo an easy task. The two pole masts are rigged with four derrick booms each. Two derrick poles with one boom each are in addition provided.

The Lyra is single screw. Her main engine is the usual type of triple expansion, vertical inverted, open-front marine engine. The cylinders are 21, 35 and 56 in. diameter by 42 in. stroke. The air pump is worked off the low pressure crosshead. Steam is generated by two Scotch, single-ended marine boilers of 14 ft. 6 in. diameter and 10 ft. 10⅛ in. length, with three furnaces, each of 45 in. diameter. The total heating surface is 4,382 sq. ft., grate surface 146 sq. ft. and steam pressure 175 lbs. The draft is natural.

The installation of electric lights is complete, even to the holds, so that darkness may not interfere with loading and discharging cargo. The dynamo and engine are by the Sturtevant company of Boston. On deck are five steam winches, a Hyde steam windlass and capstan, and a Williamson steam steering engine.

The contract for the Lyra was placed Aug. 18, 1900. The keel was laid Aug. 30, and the first frame erected Oct. 17. She was launched April 30 and received her boilers and engine on the same day. Steam was gotten up May 10 and all work was nearly completed by the 21st of the same month, when the general strike of machinists begun and work on the ship was somewhat delayed. The trial trip was made on June 6 and the same day the Lyra, after having landed her guests by a tug boat, sailed for Newport News to load with coal for Boston.

An advertisement from the bureau of equipment, navy department, calls for bids for the construction of the projected coaling plant at the United States naval coal depot, Langley point, Manila bay, Philippine islands. Bids for the complete plant only will be considered. December 3 is the date fixed for opening the proposals. It is expected that in the meantime bidders will visit the station so as to present detailed plans and specifications. General specifications and other information may be had at once from the bureau of equipment.

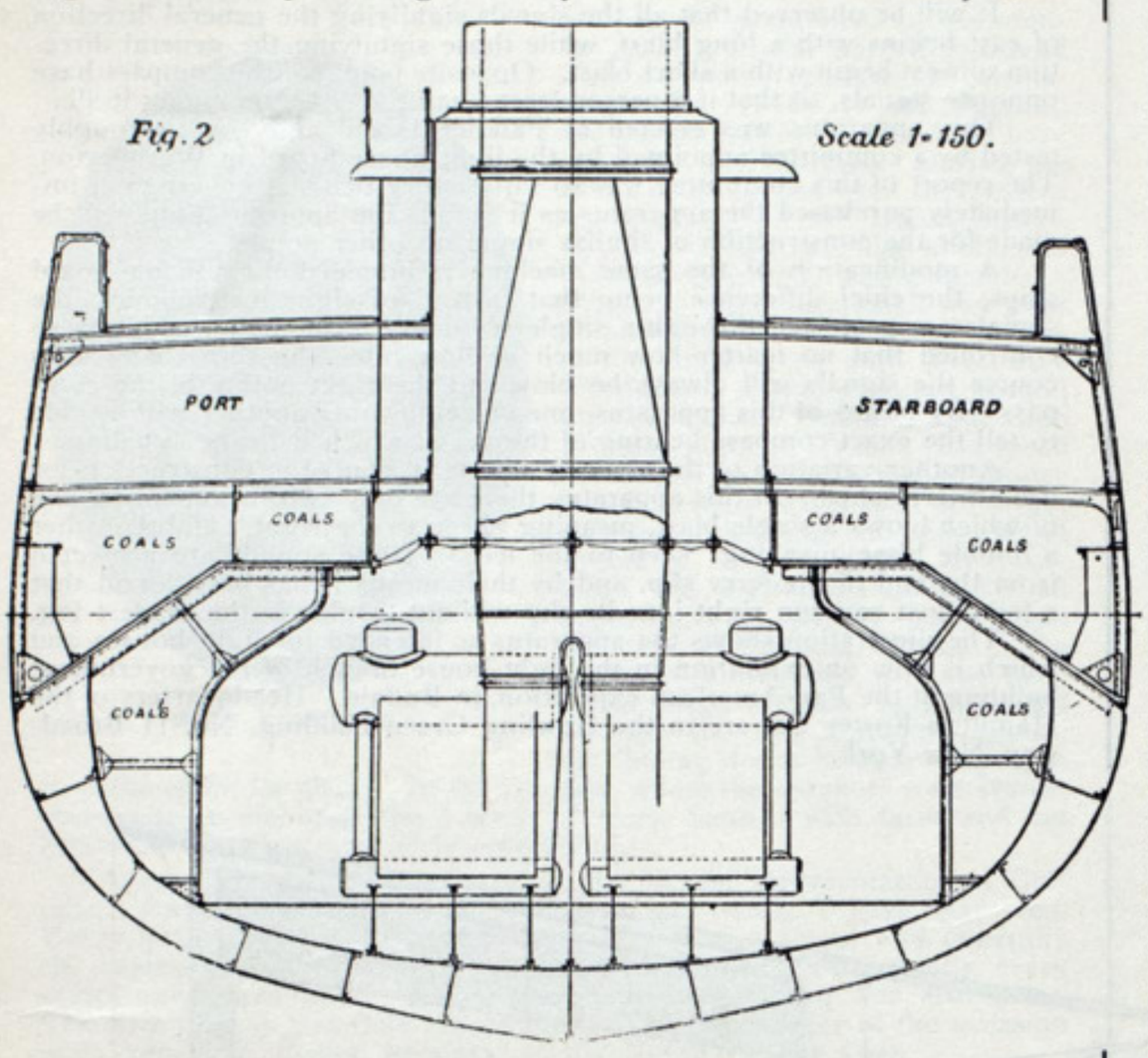
New train east via B. & O. R. R.—Leaves Cleveland 11:20 p. m. daily with through sleeper to Pittsburg and observation chair cars to Washington, Baltimore, Philadelphia and New York, giving daylight ride through the mountain scenery. June 30.

NEW RUSSIAN HIGH SPEED CRUISERS.

From Engineering, London.

The Russian navy has just ordered four new cruisers to be built—one at Windau, another at Libau, a third at Nikolaief, and a fourth at Sebastopol. German naval constructors are naturally gratified at the fact that the design of these four ships follows exactly the lines laid down for the Bogatyr, a first-class protected cruiser built for Russia at the Vulcan Co.'s works at Stettin, who were required to furnish copies of every drawing made for ship and engine—many hundreds in all. In many cases

Fig. 2 *Scale 1-150.*



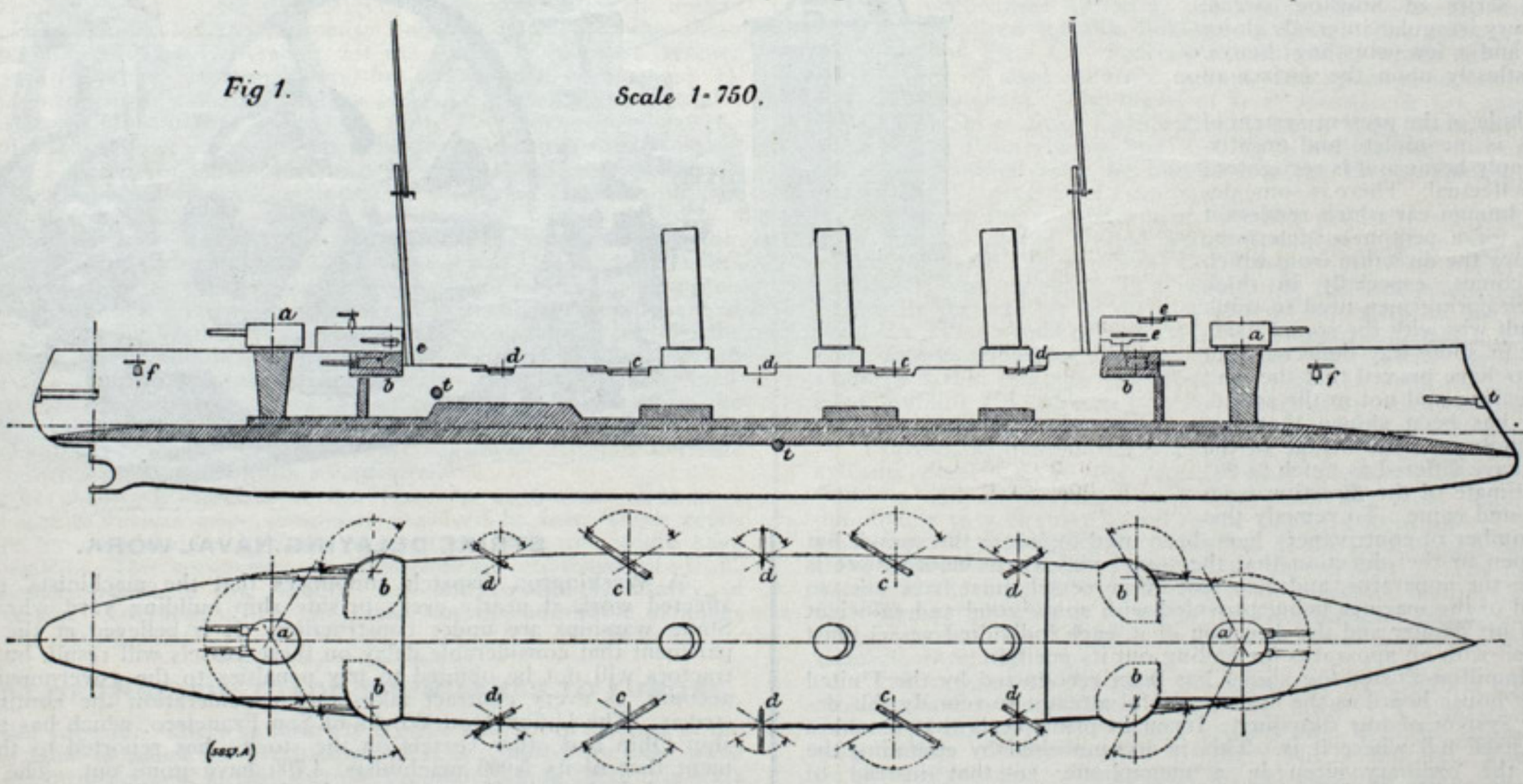
also patterns have been supplied to the Russian government, so that the work may be not only expedited, but carried out to exactly correspond with the German ship.

Accompanying this article is a general elevation with deck plan and a cross-section, which shows at a glance not only the arrangement of the protective deck and casemate armor of the Bogatyr type of vessel, but also the disposition of the guns. The Bogatyr was designed at Stettin, on the basis of an outline specification of the Variag supplied by the Russian government, with the instructions that wherever possible improvements were to be effected; and, as will presently be shown, various improvements were carried out in the direction of increased protection to the guns and of thicker armor for the conning tower, and the normal coal supply has been greatly increased without affecting the speed attained. It has been said that the five vessels of the Bogatyr class have been evolved from the design of recent Elswick cruisers, and notably of the Blanco Encalada. This statement, however, has no basis in fact, and one or two points in connection with the design almost suffice to prove the statement. The vessels of this class are of the following dimensions: Length over all, 134.21 meters (440 ft. 4 in.); length at water line, 132 meters (432 ft. 2 in.); width, 16.60 meters (54 ft. 5½ in.); depth, 10.40 meters (34 ft. 1½ in.) With complete equipment and 720 tons of coal on board the vessel will have a displacement of 6,750 tons, and a draught of 6.35 meters (20 ft. 10 in.) The principal improvements on the Variag and the other cruisers of her class may be briefly indicated. In the first place the new vessels, like the original Bogatyr, are to be provided with a poop on which the two aftermost 6-in. guns will be placed, so that their platform is raised some 8 ft. or 9 ft. higher, which gives them considerable advantage in so far as horizon is concerned, and necessarily increases their usefulness in a sea way. It is also important to note that by this change they will not interfere with the line of fire, particularly on the broadside or abaft the beam of the other 6-in. guns fitted on a lower level on either side of the ship, as shown on the deck plan. The provision of a poop also enables the accommodation of the officers to be improved; a fact of great importance for cruisers intended for service in eastern waters, because the supply of fresh air and natural ventilation is thereby greatly facilitated.

But perhaps the most important change made is in respect of the protection of the guns. The two poop guns of 6 in. caliber and the two forecastle guns of the same class are worked within armored turrets on a mounting suitable for working both guns simultaneously, whereas in the earlier Russian ship, and, indeed, in many of the Elswick ships of corresponding type, these guns, in common with others of the same type on the broadside, have only had the somewhat limited protection which an armored shield affords. Similarly, two guns on each broadside, which have radii enabling them to fire ahead in line with the keel, and two firing similarly astern, as shown on the plan, are enclosed within casemates, and all of these guns have armored ammunition hoists extending down to the armored deck. Thus, eight of the twelve 6-in. guns are protected by Krupp's special nickel armored plates, and there can be no question that this affords a better protection than a comparatively thin shield surrounding the mechanism of a gun standing on the open deck. There can be no question about the feeling of confidence which such a casemate engenders in the minds of the gunners, on whose coolness, after all, depends the accuracy of gun fire, and often the ultimate result of naval engagements. The casemate armor forms a complete protection on all sides from the splinters and fragments of burst shell, apart altogether from the great advantage of its being able to resist perforation from direct shot, and experience of naval tactics points to the fact that in future engagements explosive shells will form a very important factor, especially in cruiser attack. It is true that in cruiser design each element is necessarily a compromise, but where a high speed is to be got on a minimum draught and displacement, an important consideration must be given to the maintenance of gun fire, and this can be effectually achieved by adequate protection for the gunners. The remaining four guns, mounted two on each broadside, are fitted with large armored shields. It is also important to note that the placing of the two 6-in. guns on the forecastle and poop within one turret to be actuated by one turning gear, enables both pairs to be utilized for firing on either broadside. In the earlier ships, notably the Variag, these two guns were so placed side by side with independent mountings, so that the one gun prevented its neighbor from firing in a line at right angles to the keel, and, therefore, abeam. The British navy in the later ships of the "County" class have adopted this system for the 6-in. bow and stern chasers, which are also enclosed in armored turrets.

The cross-section of the ship which accompanies this article is interesting as showing the construction of the ship as well as the arrangement of the armored deck. It will be seen that there is a double bottom which extends for the full length of the ship, and in the way of the engine and boiler rooms it is carried up to the armored decks with plating as thick as the outside shell, in order to afford protection against torpedo attack. It will be remembered that when the question of the construction of cruisers was brought before the Institution of Naval Architects, at their meeting at Newcastle-on-Tyne, some months ago, this question was raised, and it was pointed out that in high speed cruisers this system of construction which has been adopted in the Bogatyr, and also in the four new ships of the same design, was not carried out in high speed Elswick cruisers. The protective deck has a thickness of 33 millimeters (1 5-16 in.) in the horizontal center parts while the sloping part of the deck is of 73 millimeters (2⅞ in.) special nickel steel, and in view of the curve offers a very good resistance to the penetration of shell, and is eminently satisfactory when the displacement of the

Fig 1. *Scale 1-150.*



ship and her speed are taken into account. And here, before departing from the question of protection, it may be said that protection of the turret guns is of 125 millimeters (5 in.) in thickness at the front, the material being of hard steel, while at the back it is 90 millimeters (3½ in.) in thickness of soft nickel steel; the ammunition hoists are also of nickel steel 75 millimeters (3 in.) in thickness. The casemates are 80 millimeters (3⅛ in.) thick in front and 35 millimeters (1⅜ in.) at the back.

There is a further improvement in the Variag design in respect that, in addition to the magazines forward and aft, there is one of considerable size amidship, so that the supply of ammunition to the guns amidship is much quicker, and is maintained with less likelihood of danger. There are hoists to all the guns, worked by electric power, but fitted also with gear for operating them by manual labor. As to the coal supply, it may be noted that while the enormous supply in the Variag was given as 600 tons, it is 720 tons in the case of the vessels of the Bogatyr type, the total coal capacity being 1100 tons.

While the Variag had Niclausse boilers, the Bogatyr and the four other ships now being ordered will have sixteen Normand-Sigaudy boilers to supply steam to the twin-screw triple-expansion four cylinder and four crank engines, which are to develop 20,000 I.H.P. and to give a speed of 23 knots. The general appearance of the vessel will be easily seen from the elevation which accompanies this article.

HAMILTON-FOSTER FOG SIGNAL.

Few persons who are not familiar with the subject have any idea of the amount of time and money that has been spent in attempts to render navigation safe and practicable under the ever-changing conditions of wind and weather. The United States light-house board has done its work so effectually that a person can sail entirely around seaboard and lake coasts without ever being out of sight of a light-house, and every channel and entrance is clearly marked. The most careful scientific researches have been made for the purpose of ascertaining which is the most powerful and effective light and how lenses should be arranged so that these lights shall carry to the greatest distances. Where light-houses cannot be built, light ships are anchored, and where a light ship cannot live, gas buoys and other devices of the buoy kind have been placed.

In daylight, this immense system enables the mariner to recognize any part of the coast that he may approach. In the darkness his position is equally clear to him, because every light is different, some being white, some red, some flashing and some steady, and every one of them absolutely reliable from sunset to sunrise. But the moment a fog settles down upon the sea, the whole system becomes absolutely useless, and light-houses which have cost hundreds of thousands of dollars to build and equip are powerless to render the slightest assistance to the mariner. Instead of sight, he must now depend upon hearing, and his only guide is a series of howling sirens, placed at very irregular intervals along the coast, and a few whistling buoys, tossing restlessly upon the surface of the waves.

The whole of the present system of fog signals is incomplete and unsatisfactory, simply because it is recognized as being ineffectual. There is some defect in the human ear which renders it impossible for a person to determine with accuracy the direction from which a sound comes, especially in thick weather. Seafaring men used to think that the fault was with the sound itself, which was in some way deflected, but experiments have proved that the fault is in the hearing and not in the sound, because it has been shown that two officers standing on the bridge of the same ship have differed as much as 90° in their estimate of the direction from which a sound came. To remedy this defect, a number of contrivances have been used to locate the sound, but they are open to the objection that the sound may cease before there is time to use the apparatus, and also that every vessel must have one, so that instead of the mariner being provided with some good and sufficient warning of his danger and the direction of it, each individual vessel must provide itself with an apparatus for finding out its position.

The Hamilton-Foster fog signal has been recognized by the United States light-house board as the first successful attempt to remedy this defect in our system of fog signaling. Its main principle is that it makes the signal itself tell where it is. This is accomplished by confining the sound of the ordinary siren in a megaphone, so that instead of spreading it out all round the horizon, it shall be projected toward one point of the compass. In the light-house machine there are eight of these megaphones, each pointing toward one of the principal points of the compass, and through each megaphone a different signal, consisting of long and short blasts, is blown. It has been found from experiment that when a vessel is at a short distance from the signal, say half a mile, the megaphone which is pointed directly toward it can be heard with tremendous force while the others are hardly audible. At greater distances, from two to ten miles, it is impossible to hear any sounds except those from the megaphone pointed directly toward the observer, consequently the listener knows by the signal that he hears which of the megaphones is pointed at him. If he hears one long and two short blasts, he knows that the fog signal bears S. E. from him. If he hears two signals with equal distinctness, the danger must be between those two points, S. E. E. for example. The full code is as follows:

One long blast, signal is N. of you; one short blast, it is S. of you.

Two long blasts, signal is N. E. of you; two short blasts it is S. W. of you.

One long and one short, signal is E. of you; one short and one long, it is W. of you.

One long and two short, signal is S. E. of you; two short and one long, it is N. W. of you.

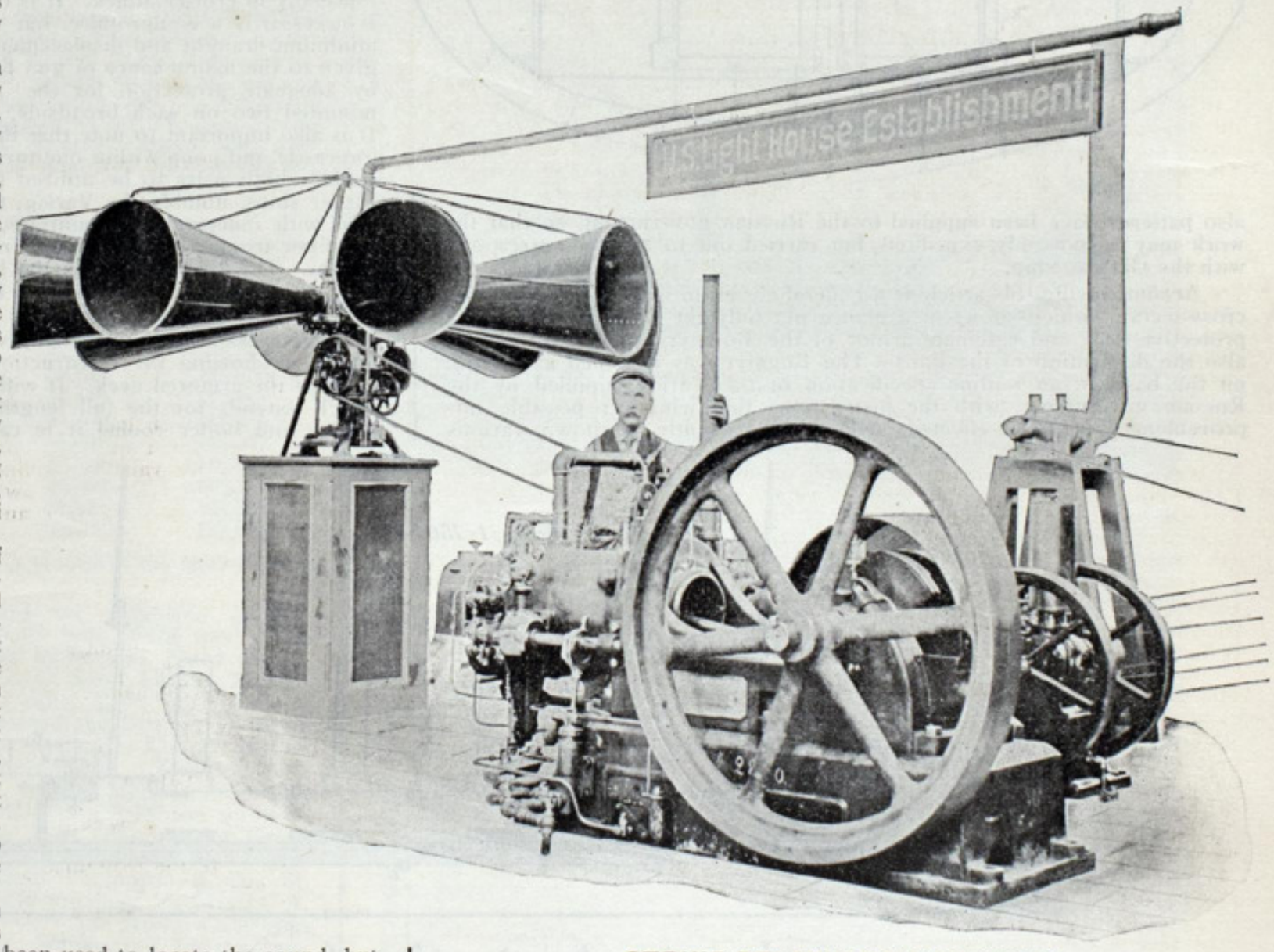
It will be observed that all the signals signifying the general direction of east begins with a long blast, while those signifying the general direction of west begin with a short blast. Opposite points of the compass have opposite signals, so that if a person learns half the code, he knows it all.

This apparatus was erected at Falkner Island and was thoroughly tested by a committee appointed by the light-house board in Washington. The report of this committee was so satisfactory that the government immediately purchased the apparatus as it stood, and appropriations will be made for the construction of similar signals at other points.

A modification of the same machine is intended for use on board ships, the chief difference being that instead of eight megaphones, the signals are projected through a single revolving megaphone, which is so controlled that no matter how much or how often the ship changes its course the signals will always be blown to the right points of the compass. By means of this apparatus, one vessel meeting another will be able to tell the exact compass bearing of the vessel which it hears signaling.

Another variation of the same system is in course of construction for use on ferry slips. In this apparatus there are only two megaphones, one of which blows a single blast, meaning "keep to the right," and the other a double blast, meaning "keep to the left." These sounds are projected from the end of the ferry slip, and by their means it has been found that a ferry boat can run right into its slip without trouble in the densest fog.

The illustration shows the apparatus as intended for light houses and which is now on exhibition in the light-house branch of the government building at the Pan-American exposition, in Buffalo. Headquarters of the Hamilton-Foster Co. are in the Bowling Green building, No. 11 Broadway, New York.



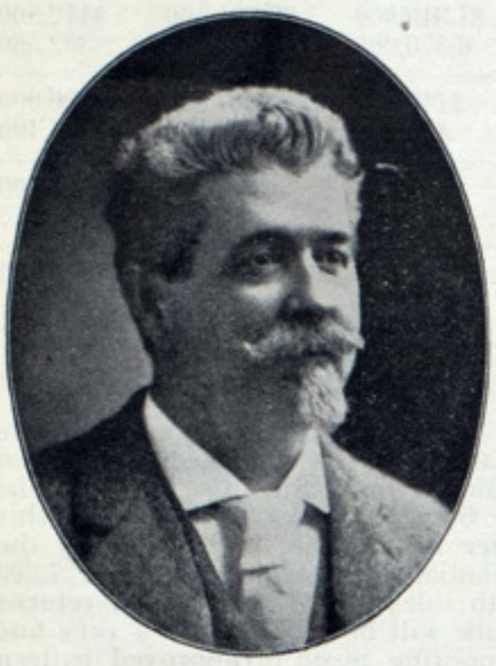
STRIKE DELAYING NAVAL WORK.

A Washington dispatch announces that the machinists' strike has affected work at nearly every private ship building yard where United States warships are under construction. It is believed at the navy department that considerable delay on these vessels will result, but the contractors will not be obliged to pay penalties to the government on that account, as every contract takes into consideration the contingency of strikes. The Union Iron Works of San Francisco, which has the battleship Ohio and other vessels on the stocks, has reported to the department that of its 5,000 machinists, 4,700 have gone out. The company granted them their demand for a nine-hour day, and made other concessions, but declined to give the advance in wages demanded. Lewis Nixon of Elizabethport, N. J., reports that he has secured the return of a number of his men through making concessions. The William R. Trigg Co. of Richmond, Va., and the Risdon Iron Works of San Francisco are also suffering from the strike. Some naval officers express the opinion that work on every naval vessel under construction will be delayed for the period taken to settle the strike.

Colonial and Yosemite are the names selected for two large freight steamers which are being built by the Detroit Ship Building Co. for Frank E. Kirby and others of Detroit and which will be launched next month.

TESTIMONIAL TO MR. MORFORD.

Chicago, June 12.—It is common enough for marine men to change their places of habitation, but such a testimonial of esteem and downright affection as was given T. T. Morford Monday night is most uncommon. On that score, the event is worthy of being chronicled in the Marine Review. When Mr. Morford was appointed manager of the Union Steamboat Co. and Lehigh Valley line, with headquarters at Buffalo, last April, the first thought of his old associates in Chicago was to give him a little dinner at one of the clubs, but this idea had to be speedily abandoned, for the number of people who wanted to attend such a function passed all calculations. Everybody in the shipping and marine business seemed to "have it in" for Mr. Morford. During the thirty years he had been the western representative of the Union Steamboat Co. he had extended kindnesses to so many people, who demanded a chance to repay in a small way what he had done for them, that the plans of the dinner grew until there were seventy-five people gathered around the tables at the Union League Club Monday night to bid him God-speed in his new home. To talk of money in connection with such an event may be in seeming bad taste, yet it should be considered that Mr. Morford's old friends clamored for an opportunity to pay $7 for a plate for this testimonial dinner. The tables were arranged with the head in the large rotunda, and extended through the two adjoining rooms, the folding doors being swung open to make room for them. In the rotunda, where the speakers were seated, there was an elaborate floral piece of roses, banked with ferns and cut flowers. The effect was fairly entrancing.



MR. T. T. MORFORD.

Around the tables was gathered the largest representation of Chicago's commercial interests as related to lake traffic I have ever seen. Every grain shipping house had its representative there, and generally the representative was the active head of the firm. Practically every vessel agent was there. Every marine insurance man was also there. The Erie railway was fully represented. The toastmaster of the occasion was Volney W. Foster, president of the Union League Club.

In describing this dinner it is difficult not to run into sentiment, for sentiment played a large part in every speech. It was an outpouring of hearty goodwill toward Mr. Morford. It was not strange that in replying to the speech of the toastmaster in presenting him with a magnificent loving cup Mr. Morford showed a depth of feeling which threatened to end his speech then and there. When this loving cup was passed around the board a spontaneous offering of goodwill rounded out the proceedings of a dinner unique in the marine annals of Chicago.

The list of formal toasts was as follows: E. J. Henry, for the Lake Line Agents Association; John G. Keith, for the Lake Carriers Association; J. Henry Norton, for the shippers; C. A. Macdonald, for the underwriters; F. A. Wann, for the railroads; John T. Sickel, for the ocean steamship lines; Charles E. Kremer, for the admiralty lawyers; Homer J. Carr, for the press; Homer Peters, for the elevator companies; D. Sullivan, for the vessel agents; Murray Nelson, for the board of trade; W. O. Johnson, for the Erie railway.

Of all the affairs I have attended during a long service in newspaper work I was never at one in which the element of kindly goodwill by associates, competitors and rivals played so large a part as in this testimony to Mr. Morford.

Mr. Morford's career as a steamboatman fills his entire active life. He came here, first with the New York Central line, but in 1869 he became connected with the Union Steamboat Co., when Washington Bullard was Chicago agent. When Mr. Bullard was appointed general manager of the company in 1873, Mr. Morford succeeded him as the western agent of the company. Full twenty-eight years were passed in that position until his appointment to the head of the line last April. It was the remembrances of these twenty-eight years which made the dinner the striking testimonial it was to the good-fellowship of Mr. Morford in all his dealings. As one speaker suggested, it was a heritage more to be valued than riches for his children.

In spite of myself this report has run into sentiment. But as a matter of fact there was more sentiment displayed by men whose reputations are for cold-blooded business propositions than one would have ever suspected. The committee of arrangements consisted of J. C. Evans, western agent of the Anchor line, and George E. Marcy of Armour & Co. To them is due the praise for the admirable arrangements of the dinner.

H. J. C.

SUBJECT OF THROUGH TRADE FROM LAKES TO EUROPE.

Buffalo, June 12.—There is naturally a large amount of interest in the venture of what is called the Counselman fleet to connect the lake trade with the ocean direct, and at this stage of the undertaking there is a wide difference of opinion as to the probable success of the enterprise. As a rule I find that lake men condemn the effort as foolish and sure to bring disaster, though on the part of the company itself there appears to be entire confidence of success.

One lake man who has had considerable disagreeable experience in navigation of the waters, as well as the locks, of the St. Lawrence route, is sure that the boats will be pulled off after two trips. He says that it is practically impossible to make one of these locks with a large boat, one that will just go through it, without having to pay for a lock every now and then. He is only one of several Buffalo vessel men who have had to go down into their pockets to prove what he says. He notes that the course through these locks is so crooked that a boat cannot be squared up as a large one would have to be, in order to make them safely. And then there is always a bridge to pass besides, which greatly complicates the situation.

The insurance people say that the St. Lawrence river is fit for no craft larger than a "pin flat" and will always be distinctly dangerous, canals or no canals. They say that not to mention the loss to the first steamer, the Northman, from special accidents on the way down, which they estimate at $10,000, she has demonstrated the fact that insurance rates must remain practically prohibitive. On the hull alone the rate is said to have been a matter of 4 per cent., or $6,000 on a valuation of $150,000, and this for the single trip east. The cargo, of say the same value on the average, would have to pay 1¼ per cent., which is close to twice what it would have to pay via New York. The question is how are these difficulties to be overcome?

An insurance man figures that the Northman is not going to be able to complete her third trip this season, at least unless she makes far better time hereafter. Of course it is hardly expected that she will be thirty-five days again this season going one way, but if she is to take on a cargo of merchandise in Hamburg or any other European port, she will be a long time loading it, as compared with such work on the lakes. Someone says that she will have to hustle if she makes her third trip over before the St. Lawrence reaches the ice period again. I find that the insurance people are quite as much against the venture as anyone, holding that the St. Lawrence route, even below Montreal, is very undesirable to them at any rate that they have so far obtained.

Now as to the other side. It is held that the freight over, stated as being $20,000, is alone enough to attract anybody who can figure at all on future prospects. There is no effort to deny that the boats must lighter up here, as the North Town has just done, leaving 35,000 bushels here to be replaced by machinery at Montreal. The chief claims appears to be that there is a great amount of delay and consequent dissatisfaction to importers of merchandise, especially dry goods, that comes over to the lake district. There is not only the difficulty at the start, but in coming via New York there are heavy losses from damage in handling, stealings and the like, which can not be charged up to anyone. Now if these goods come to Buffalo or some other lake city direct from Europe there will be no delay and any loss on the way is at once charged up to the boat.

It is held that as soon as our lake importers understand what direct shipment means to them they will be willing to pay the extra freight for the immunity it gives from delay, loss and worry. It may take some time to work up such a trade, but it is held that it is sure to come if the proper effort is made. Just what these boats will do in winter is not stated, but if they are on the ocean they will not need to be idle.

JOHN CHAMBERLIN.

NEW COMBINATIONS IN THE STEEL INDUSTRY.

Great changes are taking place among steel companies of considerable magnitude and at the present moment it is impossible to tell the relative ownership of several whose plants are in the state of Pennsylvania. It was officially announced in New York Wednesday that the Pennsylvania Railroad Co. had acquired control of the Pennsylvania Steel Co. and had admitted the Reading Railroad Co. to a minority interest. The Pennsylvania Railroad at one time owned the Pennsylvania Steel Co., but at the time negotiations were begun for its purchase the railroad held only 10 per cent. of the stock of the steel company. The capital stock of the Pennsylvania Steel Co. was recently increased to $50,000,000, of which half is preferred and half common. The company is quite independent as far as ore supplies is concerned, having some time ago acquired valuable holdings in Cuba. The company also owns the Maryland Steel Co., Sparrow's Point, Md., which has a capacity of 400,000 tons of steel rails per annum, and operates in addition a large ship building plant. The house of J. P. Morgan & Co. announces that the United States Steel Corporation is in no way interested in the purchase of the Pennsylvania Steel Co. It is well known, however, that the interests identified with the purchase of the Pennsylvania company are friendly to the great steel corporation.

Following the announcement, which is generally accepted, that President Schwab of the United States Steel Corporation has purchased a control of the Bethlehem Steel Co., being a successful bidder against the Vickers-Maxim company, is a report that the Bethlehem works will be eventually turned over to the new interest in control of the Pennsylvania Steel Co. This would permit the new company to build a warship complete, armor, armament and all. Another report within the range of possibilities is that this new organization, together with the United States Ship Building Co., now in process of formation, may eventually be operating in harmony or in unison with the United States Steel Corporation.

Previous to the announcement from New York regarding the Pennsylvania Steel Co., it was reported that a combination involving the Cambria and Pennsylvania steel companies was under way. This was due mainly to a circular issued to the Cambria stockholders setting forth plans for a new company, to be known as the Conemaugh Steel Co., and to be incorporated under Pennsylvania charter July 1. The incorporators named in the circular are all officers or directors in the Cambria Steel Co. The proposition is to make the Conemaugh Steel Co. a vehicle of reorganization, the business to be continued under the name of the Cambria Steel Co.

"It is proposed," President Stackhouse of the Cambria company says, "to organize a corporation under the laws of Pennsylvania with an authorized capital of $50,000,000, divided into 1,000,000 shares of the par value of $50. Of this capital, $5,000,000 will be reserved; $45,000,000 will be presently issued. Of the $13,050,000 resulting from the sale of the 580,000 shares of Conemaugh stock, $11,680,000 will be applied as follows: In payment of the existing debt of the Cambria Co., $3,500,000; to construction work undertaken, $1,500,000; for new furnaces, ovens, mills and water works, $5,500,000; for additional working capital, $1,180,000. The balance goes to pay the commissions, $200,000, and as compensation to the underwriting syndicates, $1,170,000."

It is announced that the resignation of Henry Wick as president of the National Steel Co., to take effect July 1, was due to a disagreement with officers of the United States Steel Corporation concerning the removal of the offices of the former company to Youngstown, O. A five-year lease of a building at Youngstown had practically been concluded, but it is stated now that the plan has been abandoned.

AN OPTIMISTIC VIEW.

The veteran Pittsburg ironmaster, B. F. Jones, who for fifty-four years has been prominently identified with the iron and steel industries, in an optimistic interview as to the future of the domestic and foreign trade, says this country will make new records in coming years.

"But to me the most impressive factor in our modern life," he said, "and one that is very important in our material development, is that the individual man counts for so much more than he used to. The vast increase of our population is not so much of a wonder as the way in which the power of every unit of our population has been multiplied. The relation of this fact to iron consumption has been so well established that iron by common consent has become a sort of barometer of civilization and progress. While we have reached a per capita consumption of 400 lbs. of pig iron in the United States, China's rate probably wouldn't reach 4 lbs., with all her millions.

"As a familiar illustration of the way in which our industrial power has been multiplied, I recall that in the early days of my connection with iron manufacture in the forties it took three men to handle a 150-lb. bloom in our forges. Now a single man—and he may wear kid gloves if he choose—has only to pull a lever and a 50-ton mass of molten metal is lifted and carried wherever he wants it. And the mechanism of trade has increased in the same way. Our banking and currency and credit systems are inconceivably beyond those of the early days. I can sit in this office and transact in a day as much business in volume as all Pittsburg did in a day when I was a young man.

"The increase in individual producing and consuming capacity is due to a variety of causes which represent the increasing complexity of life in this country. A very important factor in it all has been the perfecting of the means of transportation. We must not forget that the railroads have made a large contribution to the present conditions. For example, it costs no more to send a barrel of flour from St. Paul to Liverpool today that it once cost to send it from Washington County, Pa., to Pittsburg. The general diffusion of intelligence today is a striking feature in our industrial development. The average degree of skill in the labor of today is much above the level of the last generation. Never before have wage-earners been readers as they are today. I cannot but contrast the intelligent faces of the men in our works today with the inert countenances of so large a proportion of the workers of the earlier years. The workingmen of today are reading and thinking."

The Pacific Steam Navigation Co. of San Francisco has just awarded a contract to Clyde builders for the construction of four steamers for its South American service. The names selected for the steamers are California, Victoria, Mexico and Panama. The vessels are each to be 400 ft. in length, 52 ft. beam and 29 ft. depth. The contract means an outlay of considerably over $2,000,000.

ANNUAL MEETING OF CRAMP COMPANY.

A quarterly dividend of 1¼ per cent was declared at the annual meeting of the Wm. Cramp & Sons Ship & Engine Building Co. in Philadelphia a few days ago. All of the old directors were reelected and the board reelected the old executive officers. The annual report of the company for the year ended April 30 compares with the 1900 figures as follows:

	1901.	1900.	Decrease.
Gross	$7,319,000	$7,791,560	$472,560
Cost material, labor, etc.	6,576,000	6,878,560	302,560
Balance	$743,000	$913,000	$170,000
General expenses, interest, etc.	451,228	376,738	*74,490
Balance	$291,772	$536,262	$244,490
Dividends	242,000	242,000	.....
Surplus	$49,772	$294,262	$244,490

*Increase.

IMPORTANT SLIP AND DOCK JOB.

Hingston & Woods, contractors of Buffalo, are engaged upon the construction of a slip at that place that involves a very large amount of dredging. The slip is for the Lackawanna Iron & Steel Co., and is to be about 3,200 ft. long and 200 ft. wide between docks. One-half of this slip is inside the shore line, the other half in the bay formed by the Stony Point breakwater. Very substantial crib docking of about 7,200 lineal ft. will be constructed upon both sides of the slip, having returns on the face of the bay. This crib work will be topped with a very fine class of concrete pier. Substantial mooring posts of approved pattern will be placed every 60 ft. on the pier. The land and water space back of the piers and bulkheads will be filled up with material dredged from the slip, and a large piece of ground, probably about 40 acres, will be reclaimed. The work is to be completed by September 1, 1902.

A Baltimore dispatch says that another great corporation is planned as the outcome of the deal for merging the Atlantic Transport Co. and the Leyland line. It is said that the new company will be capitalized at $150,000,000 and will embrace not only the Atlantic Transport and the Leyland line, but will also include other steamship companies.

The Hamburg-American liner Deutschland arrived at Plymouth last week with 1,020 passengers, having accomplished the passage from New York in 5 days, 12 hours and 16 minutes. This creates a new record for the southern or longer route.

INCEPTION OF CONSOLIDATED LAKE SUPERIOR CO.

Mr. Theodore C. Search, president of the National Association of Manufacturers, gave out in Detroit last week the early history of the Consolidated Lake Superior Co. at the Sault in the development of which Mr. Clergue secured his interest and that of several other Philadelphia capitalists. Discussing the enterprises he said:

"We started on our power project at a time when no one cared to put money into anything. It was in the panic times of 1893, and we made up our minds that any development we should undertake would have to be paid for by our own money. The canals on the Canada side were shorter, and for that reason we undertook our first work on that side of the river. We developed 20,000 H.P. Then came the necessity of utilizing it, as there was then no individual demand for it. We accordingly built a pulp mill. Then came the panic, and there was no demand for the pulp. This necessitated our storing it wet, and it spoiled on our hands. To add to this came the paper panic when no one knew from one day to another what the price of paper would be, and it went from bad to worse. We then hit upon a plan to manufacture our pulp dry and invented the machinery to do it with. The result is that we are now making our pulp dry, and are shipping it to all parts of the world in that condition, thereby saving the freight we paid on the 55 per cent. water formerly in the material.

"Times got better. We were able to interest other capital, and we decided to begin operations on the American side on the land we had taken the precaution to secure. The strip was 400 ft. wide, running through the middle of the town of Sault Ste. Marie. Other parties had attempted to develop water power, but had made a failure of it. The town then took it up; we came along and secured its co-operation, with the result that there is now a canal 12,000 ft. long and 250 ft. wide, except where it goes through the solid rock. Here it is 200 ft. wide and 21½ ft. deep. The work there is about 90 per cent. finished and we expect that it will be completed by fall. The canal ends in a power house nearly 1,400 ft. long, built of cement blocks, made on the spot and fitted with the pent stocks through which the water passes. There are eighty of these pent stocks, and to each pent stock there are four turbine wheels, making 320 turbine wheels that will be in operation when the work is complete.

"Then came the industries which are to use the power. The Calcium Carbide Co. will take 20,000 H.P., and the American Alkali Co. 15,000 H.P. We could sell the remainder of the power, but we will need it for running our own works. These will be a large paper mill and iron and steel mills. To the latter we will send our ore from the Canadian side, thus giving us access to the American markets, while from the Canadian side we have access to the markets of the world.

"What do I consider the future of the territory surrounding the Canadian Sault? I think it is a veritable storehouse of minerals which can be drawn on for many years to come. The steel mills now being built at the Canadian Sault will have a capacity of 2,600 tons a day. There is an unlimited supply of ore and it is of the finest quality. The ore from our first mine, to which we were compelled to build 12 miles of railroad, is a good Bessemer, and the ore from the second mine, to which we had to extend the railroad, is as good as any Bessemer ore now known to exist. It runs very light in phosphorus. The timber on the land north of the Canadian Sault is also of the best and very valuable. We will eventually utilize all the resources of the property."

NEW CLASSIFICATION OF NAVAL VESSELS.

President McKinley has just signed an order to carry out the provisions of a law of congress for a new classification of naval vessels. Ever since the navy was established the classification has been by the number of guns carried, a proper rating when guns determined the character of the vessel. In those days of seventy-fours and old wooden ships with several tiers of gun decks, no vessel carrying less than fifty guns in its main battery was a first rater. Nowadays, with powerful breechloading rifles, armored turrets and armored sides, the biggest battleship doesn't carry half that many guns in the main battery and many large ships have not half that number in main and secondary batteries combined. For years the navy department has been trying to secure a reclassification, but congress was indifferent, and it was not until the last session that a rerating bill was passed.

The new classification is by displacement or the weight of water in tons displaced by the ship. There are four new ratings, and ships of certain types are not to be rated. The unrated class consists of torpedo boat destroyers, torpedo boats, tugs, sailing ships and receiving ships. The regular ratings are as follows: First rate, men-of-war only, 8,000 tons and above; second rate, men-of-war of 4,000 tons and under 8,000 tons, and converted and auxiliary vessels of 6,000 tons and above, except colliers, refrigerating ships, distilling ships, tank steamers, repair ships, hospital ships, and other vessels for special purposes; third rate, men-of-war of 1,000 to 6,000 tons, and colliers, refrigerating ships, etc.; fourth rate, all other vessels.

Under the new classification the new battleship Texas of 5,300 tons displacement becomes a vessel of the second rate. All other armored ships, except monitors, are in the first class, the smallest of them, the armored cruiser New York, having a displacement of 8,480 tons. The big commerce destroyers, Columbia and Minneapolis, will be of the second rate, with a displacement of 7,476 tons each. Admiral Dewey's famous flagship, the protected cruiser Olympia, with 5,800 tons displacement, is also of the second rate. Under the old classification the Columbia, the Minneapolis, the Texas, the Puritan, the Olympia and the Chicago were first raters. The Puritan, a monitor of 5,060 tons, and the Chicago, a protected cruiser of 5,000 tons, become second raters.

The president's order also designates the commands to which officers of the several grades are entitled. A rear admiral, as well as the admiral, may command a fleet.

TRADE NOTES.

Mr. Stewart of the engineering firm of Stewart & McCurdy, Philadelphia, recently purchased from Hall Bros. of that city a speedy launch that is equipped with one of the well-known Hall Bros. gasoline engines. The engine is of 3 H.P. The boat makes 9 miles an hour and has given such great satisfaction that Mr. McCurdy is commending the engine on all occasions.

Capt. M. DePuy of New York, manufacturer of the DePuy Paragon boiler, recently installed in his canal steamer Acme one of these boilers that includes all improvements in the design. The boiler is 6x10 ft. Capt. DePuy says of it: "We are towing three consorts with this boat and doing the work with half the fuel burned on the ordinary canal steamer. The Acme made the run, with her tow, from Troy to New York—157 miles—in thirty-two hours, and consumed only 2¼ tons of egg coal. This remarkable showing was accomplished without covering on boiler or pipes. When the boiler and pipes are covered we expect to reduce the fuel bill by 10 to 15 percent."

"A Short Treatise on Combustion" is the title of a very interesting folder dealing with the "Hydro Carbon" system of fuel economy controlled by the Steam Boiler Equipment Co. of New York. The folder is a reprint of a paper read at a recent meeting of one of the Pennsylvania branches of the National Association of Stationary Engineers and comes from Stuart & McCurdy, Philadelphia representatives of the "Hydro-Carbon" system. This system of regulating fuel consumption is, on merit, winning its way, many large steam yachts having adopted it recently. A late order secured by Mr. Hovey, secretary of the company, is for the equipment of the tug J. C. Evans of the Great Lakes Towing Co., Chicago. The Steam Boiler Equipment Co. of New York is located at No. 20 West Houston street, New York city, and the folder can be obtained by application to that address.

Wooden berths in vessels of all kinds, and especially those engaged in passenger service, are gradually giving way to metal berths, and the change will be hastened by the attractive designs brought out of late by leading manufacturers in this line. Messrs. Leim, Irvine & Co. of 328 E. Twenty-third street, New York, make metal berths for all services from the first-class appartments of elegant passenger steamers to the special equipment of transports. They have just closed a contract for first-class berths for the steamers Korea and Siberia, building at the works of the Newport News Ship Building & Dry Dock Co. These, the manufacturers say, will be the finest metal berths ever put into a vessel.

ITEMS OF GENERAL INTEREST.

The John Schroeder Lumber Co. of Milwaukee will shortly arrange for the construction of a steamer of about a million feet lumber capacity.

Miss Ruth Hanna, daughter of Senator Hanna, has been selected by the secretary of the navy to christen the cruiser Cleveland, which will be launched at the Bath Iron Works, Bath, Me., in August.

The revenue cutter Mackinaw, designed for service on the great lakes, will be launched at the works of the William R. Trigg Co., Richmond, Va., some time during the present month.

Capt. W. W. Brown of Cleveland is the purchaser of the steel steamer Gratwick from Drake & Maytham of Buffalo. Associated with Capt. Brown in the purchase are Syracuse parties who are also interested with him in other ventures. The price is reported at $200,000.

It is said that $705,000 was paid in all for the four Whitney steamers purchased a few days ago by J. C. Gilchrist and associates of Cleveland from the Whitney estate—$285,000 for the Whitney, $177,500 each for the Merida and Oglebay, and $65,000 for the wooden steamer, the Mecosta.

A BOAT DETACHING DEVICE THAT WORKS.

There are so many worthless devices advertised for life-saving purposes that it is a pleasure to commend the apparatus that really shows its worth in actual service. Another instance of the value of the boat releasing hook made by the Standard Automatic Releasing Hook Co. of No. 17 State street, New York, comes from the daily papers of New York city, supported by a letter of commendation from the master of the United States army transport Sedgwick. This hook is used on all vessels of the army transport service, as well as on vessels of the navy, vessels of the light-house institution and vessels of other branches of the government. A cry of "man overboard" was heard aboard the Sedgwick one morning last week as the vessel, making New York harbor, was steaming slowly towards the Narrows. The man overboard was an insane hospital steward, who had managed, with his feet shackled, to escape a watch that had been placed over him and jumped into the sea. In exactly thirty-five seconds after the alarm had been given the forward starboard life-boat dropped from the davits and the drowning man was saved. Referring to the incident, Capt. H. J. Byrne of the Sedgwick says in a letter to the Standard company:

"I take pleasure in saying that the account of this rescue as published in the daily papers is correct. The boat was lowered while the ship was under three-quarters speed and the promptness with which it detached when striking the water, made it possible to perform what I regard as one of the quickest rescues I ever witnessed. I wish to bear testimony to the reliable qualities of your releasing hooks, which have never failed us on occasions when called for. I have seen them work under most difficult circumstances and have never witnessed their failure. I hope this letter may be of advantage in bringing about their universal adoption."

The Marine Iron Works, station A, Chicago, have just issued a new 48-page catalogue descriptive of their product, which they will send free on receipt of request. A separate pamphlet issued by the same company, devoted especially to "River Navigation" (shallow water stern wheel boats), will also be included if asked for. 1

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Will sell the passenger steamer Hattie. Capacity 250 passengers, 100 tons freight. John Stevenson, Detroit, Mich. July 4.

Sealed proposals will be received at the office of the Light-House Engineer, Milwaukee, Wis., until 3 o'clock p. m., July 10, 1901, and then opened, for furnishing the materials and labor necessary for the construction of the steel steam light-house tender Hyacinth, in accordance with specifications, copies of which, with blank proposals and other information may be had upon application to Captain J. G. Warren, Corps of Engineers, U. S. A., Engineer. June 13.

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Roebling's Sons, John A.....New York and Cleveland.
American Steel & Wire Co.....Chicago.

SAFETY VALVES.
American Steam Gauge Co.....Boston.
Ashton Valve Co.....Boston.
Crosby Steam Gage & Valve Co.....Boston.

SAIL MAKERS.
Baker, Howard H. & Co.....Buffalo.
Upson-Walton Co.....Cleveland.
Wilson & Silsby.....Boston.

SALVAGE COMPANIES.
See wrecking companies.

SEAM COMPOSITION AND ELASTIC SEAM PAINT.
Cole & Kuhls.....Brooklyn.

SEARCH LIGHTS.
Elwell-Parker Electric Co.....Cleveland.
General Electric Co.....Schenectady, N. Y.
Rushmore Dynamo Works.....Jersey City, N. J.
Seidler-Miner Electric Co.....Detroit.
Westinghouse Electric & Mnfg. Co.....Pittsburg.

SHAPERS.
Bement, Miles & Co.....Philadelphia.
Niles Tool Works Co.....Hamilton, O.
Pratt & Whitney Co.....Hartford, Conn.

SHEARS.
See punches, riveters and shears.

SHIP AND BOILER PLATES AND SHAPES.
Bourne-Fuller Co.....Cleveland.

SHIP BUILDERS.
American Ship Building Co.....Cleveland.
Atlantic Works.....East Boston, Mass.
Bath Iron Works, Ltd.....Bath, Me.
Buffalo Dry Dock Co.....Buffalo.
Cramp, Wm. & Sons.....Philadelphia.
Craig Ship Building Co.....Toledo, O.
Chicago Ship Building Co.....Chicago.
Detroit Shipbuilding Co.....Detroit.
Fore River Ship & Engine Co.....Quincy, Mass.
Hardy, John B.....Tacoma, Wash.
Harlan & Hollingsworth Co.....Wilmington, Del.
Jenks Ship Building Co.....Port Huron, Mich.
Lockwood Mnfg. Co.....East Boston, Mass.
Maryland Steel Co.....Sparrow's Point, Md.
Moran Bros. Co.....Seattle, Wash.
Neafie & Levy Ship & Engine Bldg. Co.....Philadelphia.
Newport News Ship Building Co.....Newport News, Va.
Nixon, Lewis.....Elizabeth, N. J.
Pusey & Jones Co.....Wilmington, Del.
Risdon Iron Works.....San Francisco.
Roach's Ship Yard.....Chester, Pa.
Trigg, Wm. R. Co.....Richmond, Va.
Union Iron Works.....San Francisco.
Willard, Chas. P. & Co.....Chicago.

SHIP CHANDLERS.
Baker, Howard H. & Co.....Buffalo.
Moran Bros. Co.....Seattle, Wash.
Reilly Repair & Supply Co., James.....New York.
Upson-Walton Co.....Cleveland.

BUYERS' DIRECTORY OF THE MARINE TRADE.—Continued.

SPARS—LARGE SIZES.

Moran Bros. Co.....Seattle, Wash.

STAYBOLTS, IRON OR STEEL, HOLLOW OR SOLID.

Falls Hollow Staybolt Co.....Cuyahoga Falls, O.

STEAM VESSEL FOR SALE.

Holmes, Samuel.....New York.

STEAMSHIP LINES, PASS. AND FREIGHT.

American Line.....New York.
Cleveland & Buffalo Transit Co.....Cleveland.
Erie & Western Trans. Co.....Buffalo.
International Nav. Co.....Philadelphia.
Red Star Line.....New York.

STEEL CASTINGS.

Seaboard Steel Casting Co.....Chester, Pa.

STEERING APPARATUS.

American Ship Building Co.....Cleveland.
Chase Machine Co.....Cleveland.
Detroit Shipbuilding Co.....Detroit.
Electro-Dynamic Co.....Philadelphia.
Hyde Windlass Co.....Bath, Me.
Jenks Ship Building Co.....Port Huron, Mich.
Queen City Engineering Co.....Buffalo.
Sheriffs Mnfg. Co.....Milwaukee.

STOCKS, BONDS, SECURITIES.

Wright, Herbert & Co.....Cleveland.

STOCKLESS ANCHORS.

Baldt Anchor Co.....Chester, Pa.
International Anchor Co.....Cleveland.

STRUCTURES OF STEEL, BUILDERS OF.

American Bridge Co.....New York.

SUBMARINE DIVING APPARATUS.

Hale Rubber Co., Alfred.....So. Boston, Mass.

SURVEYORS, MARINE.

See, Horace.....New York.
Wood, W. J.....Chicago.

TELEGRAPH—DECK AND ENGINE ROOM.

Cory, Chas. & Son.....New York.

TESTS OF MATERIAL.

Hunt, Robert W. & Co.....Chicago.
Pittsburgh Testing Laboratory, Ltd.....Pittsburg.

THERMOMETERS FOR MECHANICAL PURPOSES.

Helios-Upton Co.....Peabody, Mass.

TOOLS, METAL WORKING, FOR SHIP AND ENGINE WORKS.

Bement, Miles & Co.....Philadelphia.
Cleveland Punch & Shear Works Co.....Cleveland.
New Doty Mnfg. Co.....Janesville, Wis.
Niles Tool Works Co.....Hamilton, O.
Pond Machine Tool Co.....Plainfield, N. J.
Pratt & Whitney Co.....Hartford, Conn.
Standard Pneumatic Tool Co.....Chicago.
Watson-Stillman Co.....New York.
Wood, R. D. & Co.....Philadelphia.

TOOLS, WOOD WORKING.

Atlantic Works, Inc.....Philadelphia.

TOPOPHONE—Prevents disasters in fogs.

Colt Co. J. B.....New York.

TOWING MACHINES.

American Ship Windlass Co.....Providence, R. I.
Chase Machine Co.....Cleveland.

TOWING COMPANIES.

Donnelly Salvage & Wrecking Co.....Kingston, Ont.
Midland Towing & Wrecking Co., Ltd.....Midland, Ont.
Swain Wrecking Co.....Detroit.

TRAPS, STEAM.

D'Este Co., Julian.....Boston.
Haines Co., Wm. S.....Philadelphia.

TRUCKS.

Boston & Lockport Block Co.....Boston.

TUBING, SEAMLESS.

Benedict & Burnham Mnfg. Co.....Waterbury, Conn.
Standard Seamless Tube Co.....Pittsburg.

VALVES, STEAM SPECIALTIES, ETC.

American Steam Gauge Co.....Boston.
Ashton Valve Co.....Boston.
Crane Co.....Chicago.
Crosby Steam Gage & Valve Co.....Boston.
D'Este Co., Julian.....Boston.
Jenkins Bros.....New York.
Wood & Co., R. D.....Philadelphia.

VARNISH PAINT.

Mair, John & Son.....Philadelphia.

VESSEL AND FREIGHT AGENTS.

Boland, John J.....Buffalo.
Brown & Co.....Buffalo.
Chamberlain & Co., S. R.....Chicago.
Drake & Maytham.....Buffalo.
Elphicke, C. W. & Co.....Chicago.
Hall & Root.....Buffalo.
Helm, D. T. & Co.....Duluth, Minn.
Holmes, Samuel.....New York.
Hutchinson & Co.....Cleveland.
Keith, J. G. & Co.....Chicago.
Kennedy Hunter & Co.....Antwerp.
Mitchell & Co.....Cleveland.
Richardson, W. C.....Cleveland.
Sullivan, D. & Co.....Chicago.

VENTILATING APPARATUS FOR SHIPS.

American Blower Co.....Detroit.
Boston Blower Co.....Hyde Park, Mass.
Buffalo Forge Co.....Buffalo.
Sturtevant, B. F. Co.....Boston.

WIRE ROPE AND WIRE ROPE FITTINGS.

American Steel & Wire Co.....Chicago.
Baker, H. H. & Co.....Buffalo.
Roebling's Sons, John A.....New York and Cleveland.
Upson-Walton Co.....Cleveland.

WHISTLES, STEAM.

American Steam Gauge Co.....Boston.
Ashton Valve Co.....Boston.
Crosby Steam Gage & Valve Co.....Boston.
Signal & Control Co.....New York.

WINDLASSES.

American Ship Windlass Co.....Providence, R. I.
American Ship Building Co.....Cleveland.
Hyde Windlass Co.....Bath, Me.
Jenks Ship Building Co.....Port Huron, Mich.

WINCHES.

American Ship Windlass Co.....Providence, R. I.
Hyde Windlass Co.....Bath, Me.

WOOD WORKING MACHINERY.

Atlantic Works, Inc.....Philadelphia.

WRECKING AND SALVAGE COMPANIES.

Donnelly Salvage & Wrecking Co.....Kingston, Ont.
Midland Towing & Wrecking Co., Ltd.....Midland, Ont.
Swain Wrecking Co.....Detroit.

YACHT SAILS, FITTINGS, HARDWARE, ETC.

Wilson & Silsby.....Boston.

YACHT AND BOAT BUILDERS.

Drein, Thos. & Son.....Wilmington, Del.
Gas Engine & Power Co.....New York.
Lane & DeGroot.....Brooklyn.
Willard, Chas. P. & Co.....Chicago.

YAWLS.

Drein, Thos. & Son.....Wilmington, Del.
Lane & DeGroot.....Brooklyn.

ALPHABETICAL INDEX OF ADVERTISERS IN THE MARINE REVIEW.

The star (*) indicates that the advertisement appears alternate weeks. For addresses see advertisements on pages noted.

WANTED, FOR SALE FOR CHARTER, Etc.

Space under this heading 25 cents a line, each insertion, for three insertions or less. Special rates for periods of more than three insertions.

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—FOR SALE—New locomotive fire-box boiler. Fire-box 84½ in. long, 89 in. high, 64 in. wide. Contains 237 2¼ in. by 17 ft. iron tubes. Steam drum 36 in. diameter, 11 ft. long. Working pressure, 200 lbs. The S. Freeman & Sons Mn'fg. Co., Racine, Wis tf.

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—FOR SALE—Complete plant for steel ship building. P. O. Box 23, Perth Amboy, N. J.

—FOR SALE—Harbor tugs Owen and Delta. Engines 20x20 and 20 x22 in., respectively. Good boats. Cheap for cash. Ranney Bros., 65 Merwin St., Cleveland. tf.

—FOR SALE—Scott's Coast Pilot, 1901 edition. Great lakes and connecting waters. Fully revised. Price, $1.50. The Marine Review Pub. Co., Cleveland. tf

—FOR SALE—Charts of all the world. Charts of the great lakes always in stock. United States Hydrographic Office charts, Coast Survey charts, Army Engineer charts. We bind charts and back them with tape, so that they will last for years. The Marine Review Pub. Co., Cleveland. tf

MARINE REVIEW

VOL. XXIII. CLEVELAND, O., JUNE 13, 1901. No. 24.

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FOR HANDLING COAL AND ORE
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Cantilever and Gantry Cranes For Handling Structural Work, Marine Plates, Etc.
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P. O. Box 53, PROVIDENCE, R. I.

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Sole Builders of the ORIGINAL and ONLY AUTOMATIC STEAM TOWING MACHINE.

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STEEL SHIP BUILDERS AND DRY DOCK PROPRIETORS.

Dry Dock and Yards: 101st St. and Calumet River, CHICAGO, ILL.

Standard Automatic Releasing Device.

THE FALLS ARE SO ROVE THAT BOTH ENDS OF THE BOAT DETACH, IRRESPECTIVE OF WHICH END STRIKES THE WATER FIRST.

Will release a boat immediately in the roughest sea or under speed and can be hooked on without delay or injury to the hands of men hooking it on.

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NEW CHEESEBROUGH BUILDING,
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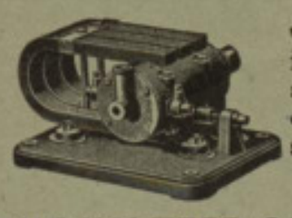

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"KEY TO ENGINEERING."

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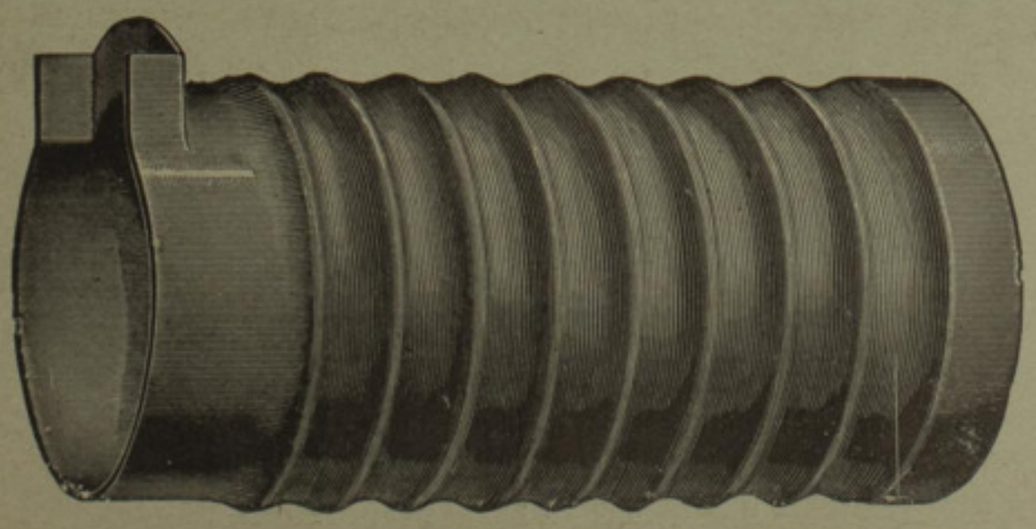

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LAND and MARINE BOILERS.

UNIFORM THICKNESS—EASILY CLEANED
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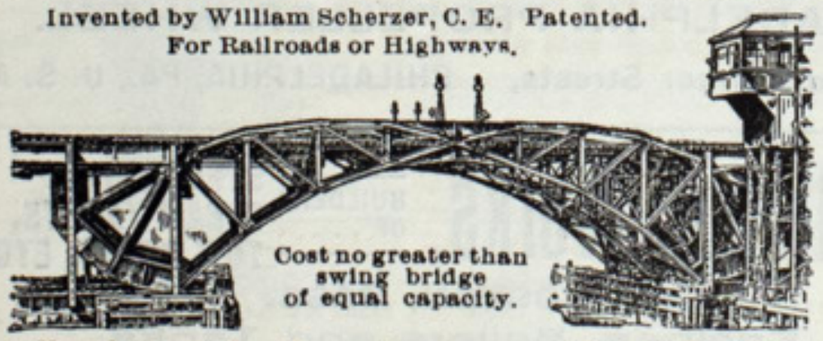

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Enables you to MAKE A TIGHTER JOINT than you can possibly make with red lead. You can do it easier, and parts can be separated at any time without breaking anything. Send for sample and circular.

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REQUIRING NO OILING OR GREASING.

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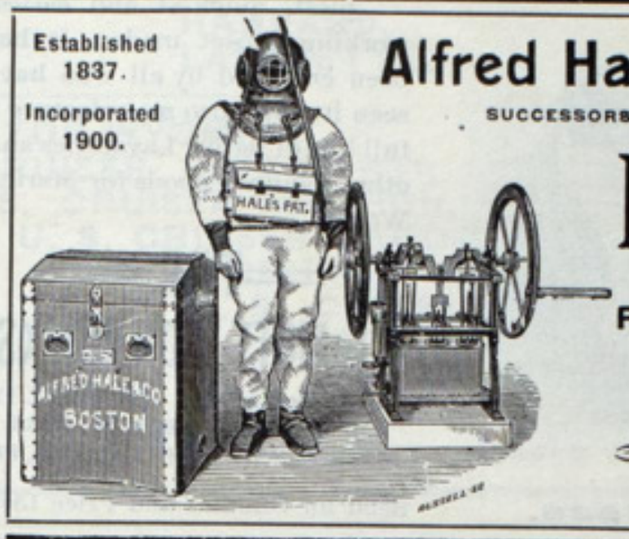

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SUCCESSORS TO ALFRED HALE & CO

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Repair Cloth.
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Pure Feed Water.
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Lower Fuel Bills.

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Prevents formation of scale, removes old scale, and reduces fuel bills.

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For Decks and all other Seams,
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High and Low Pressure Engines,
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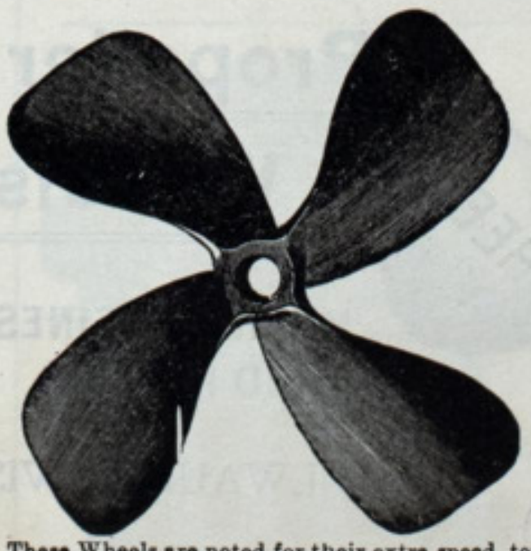

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